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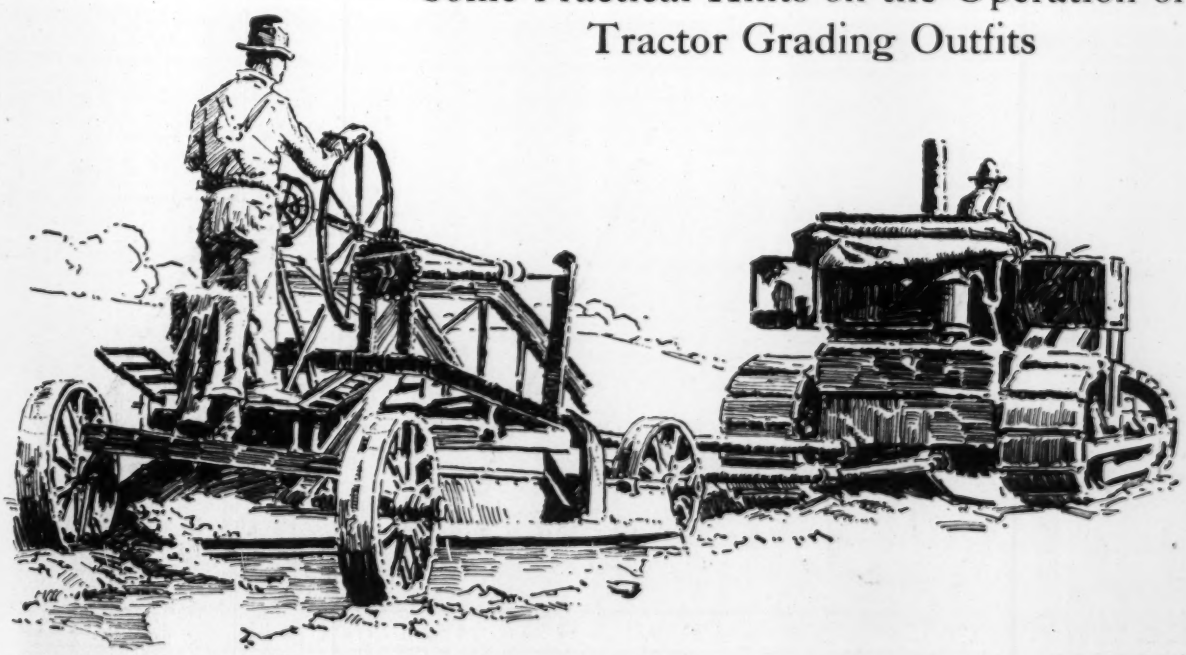
Some Practical Hints on the Operation of Tractor Grading Outfits



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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The Disarmament Proposals

It was a stroke worthy of a nation with disinterested motives to propose, in the opening address of the conference on the limitation of armaments, the scrapping of 66 capital ships. The boldness of the proposal and the challenge it gives to the intentions of other nations is an augury of a successful outcome of the conference in Washington. The start is a good one—worthy of a nation with America's peace traditions. It will hearten all who pray for a successful outcome of the negotiations.

Common Sense Versus Vaporings

REFERENCE was made in these columns last week to the addresses being made by Mr. Rowntree. One of these was delivered at a dinner, of over 1,000 covers, of the Academy of Social Science of New York. On the same program was Hugh Frayne, general organizer of the American Federation of Labor, who was expected to give labor's viewpoint on the elimination or mitigation of industrial unrest. It was an occasion for solid thought. Mr. Rowntree stuck to common sense. He was definite. His subject had a solid appeal. Here was a great occasion for the federation to appeal to an influential group interested in working toward a sound solution of the labor problem. Yet Mr. Frayne indulged in generalities. His speech was of the spread-eagle variety that would make a hit at a union picnic. There was no substance; nothing concrete. The sad part is not that this is an isolated case of lack of judgment in suiting the theme to the audience, but is typical of the fighting policy of the federation which excludes, apparently the development of policies that are economically defensible and that would win public support for organized labor. So long as the federation continues under its present unstatesman-like leadership, it cannot expect to regain or improve on the ground lost in recent years.

Double Side-Slab Roads

THE use of two side-slabs of concrete to replace a considerable mileage of old waterbound macadam in New York offers a method, where funds are limited, of securing a wide paved road at the cost of a comparatively narrow one-slab concrete road. Little criticism can be made of the design except on the count of increased maintenance. It gives a road with plenty of turnout room and, in case of need, for three-way traffic. It keeps the normal two lines of traffic well separated, and therefore increases the degree of safety. Maintenance will be increased. The center strip of penetration macadam, in the New York practice, breaks down sooner than the concrete, and particularly at the edges requires rather constant repairing. In rebuttal it may be said, however, that the narrow concrete slabs will probably develop fewer cracks than will a single slab 18 to 20 ft. wide, and that the reduction in crack-filling will counterbalance in part at least the extra cost of repairs on the penetration macadam. A final thought to be kept in mind is that the parallel slab road is a reconstruction design. Its fitness and its cheapness as a main road structure result largely from the fact that an old macadam pavement is in place as a foundation for the concrete slabs and for the macadam center strip.

Intimidation Enjoined

TWO recently issued injunctions against strikers emphasize a solid point of view toward the conduct of strikes. The one was at Raleigh, N. C., in connection with a strike in the printing trade, the other in the milk strike at New York City. The purport of the injunctions is the same—that no means may be used by the strikers to annoy or threaten those who remain at or return to work. There is left to them only strictly peaceful means of procedure. By detailed statement all the usual methods of bringing pressure on loyal employees or strike breakers are enjoined. The North Carolina court, for example, as two of the specific prohibitions, forbids the strikers, (1) "From following after the complaining employees (the injuction was sought by the employees who continued working) or any other employees of the printing companies for the purpose of worrying, harassing or disturbing them, or for the purpose of talking to them on the subject of their employment if said employees shall notify the defendants that they do not want to be talked to on this subject. (2) From using any threats, gestures, or engaging in any conduct of any kind calculated to disturb, annoy or put in fear any of the complainants herein." The New York decision is equally specific. Heretofore, "peaceful" picketing has been held legal. The intent of these injunctions evidently, is to prevent so-called "peaceful" picketing from becoming a means of intimidation. If the North Carolina and New York views as to the proper limits of methods of strikebreaking become general, the only means left to strikers to gain their point would be the obvious conferences with employers, the inconvenience and loss to owners resulting from the stoppage, the presentation of their case to the public through various channels of publicity, and the use of various official agencies for mediation. This is as it should be, and is demanded by our constitutional guarantees. The wonder is that such sweeping prohibitions of all means of instilling fear in the minds of those who work have not become general before.

Maintaining Worker's Standards

RESISTANCE to accepting lower standards—or to what are believed to be lower standards of living—is bound to be strong. This has been forcefully illustrated during this period of depression. Men applying for work at agencies frequently go away without taking jobs, though many are available, because they refuse to accept the lower wage scale now prevalent to do work that they consider of a lower order, or to work under less favorable conditions. This desire to maintain a higher standard is laudable, but in times like the pres-

ent, men must temporarily take what they can get, trusting to better times to permit them to return to their former standards. Another phase of this unwillingness to change standards was illustrated this summer on the construction work on the Catskill aqueduct. It was difficult to maintain full forces due to the unwillingness of men to work in isolated places. It is quite likely that with the curtailment of immigration this difficulty of filling forces on isolated jobs is likely to become widespread. The obvious effect will be to force a higher wage scale on the remote works.

Pit-Run Gravel Concrete Roads

PIT-RUN gravel mixtures have demonstrated their utility for concrete road construction to the satisfaction of the Iowa Highway Commission. This is a conclusion of immense importance to all in the states of the Mississippi Valley, and in all other states where the prevailing gravels have a sand content exceeding 30 to 40 per cent. In these states practically all the gravel deposits south of the Wisconsin drift area run small both in pebble content and in the size of the pebbles. A screened mixture from any of these gravels is excessively costly because of the great wastage of sand in screening. If screened materials in arbitrary proportions are rigidly demanded the coarse aggregate at least has to be imported, and importation cannot meet the demand both because means of transportation are not sufficient and because consumption in the few states having materials to export limits very narrowly the surplus available for a foreign market. All states are building roads, each to about the limit of capacity of mercantile producers to furnish materials, so that none can materially aid another which lacks materials.

These facts must be kept in mind in passing comment on a practice which by most highway engineers has come to be regarded as dangerous. It must also be remembered that the pit-run gravel concrete roads of Iowa are being constructed with a care and under a control by the laboratory which was not dreamed of when the pit-run gravel concrete roads which have so disastrously gone to pieces in New York and other Eastern states were built. The impulse to criticize is modified as this care in controlling the construction is comprehended and as the vital fact is realized that concrete roads in Iowa would cost more in many cases and could not be built in some cases unless excess-sand aggregates could be utilized.

Cleveland Leads Big Cities in Adopting City-Manager Plan

OPPONENTS of the city-manager plan who have been confronted with proof that it has been a marked success where tried have urged that it might do for small cities but would never work for large ones. This argument has been persisted in nothwithstanding the fact that four cities with over 100,000 population have prospered under city managers for considerable periods: Akron, Ohio, with 208,000 population; Dayton, Ohio, 153,000; Grand Rapids, Mich., 138,000; Norfolk, Va., 116,000. Such reasoning did not deter the voters of Cleveland, with its population of 797,000, from adopting the manager plan by a decisive vote on Nov. 8.

It should be noted that the amendments to the Cleveland charter meet one of the most valid of the arguments brought against the commission-manager plan for a large city, which is that a commission or council of only five members is not truly representative. This charge was met several years ago by Richard S. Childs and other advocates of commission-manager government by proposing that the larger cities should be divided into "wieldy districts," the number of districts depending upon the total size of the city and other local conditions, each district to be represented on the commission. Not only has this plan been adopted at Cleveland, but also proportional representation, after Jan. 1, 1924, by which the Council will consist of 25 members, chosen by proportional representation from four districts.

The extension of the city-manager plan to a city rapidly approaching a million people promises much in terms of municipal efficiency and of opportunity to engineers—the latter because better city government means the employment of more engineers, under improved conditions, even if the manager himself be not an engineer. It may also be noted in passing that a large percentage of the two hundred or more city managerships already in existence are filled by engineers.

In both opportunity and emolument the city managership of Cleveland should and probably will be the most important appointive municipal executive in the United States. To the highest type of men the opportunity will outweigh the emolument, whatever the latter may be.

The citizens of Cleveland should not rest content with the mere adoption of the city-manager plan, for that is only the beginning of what must be done to reap all its possible benefits. No matter how excellent the machinery of government provided in moments or days of zeal the people of any city must choose fit men to select its chief operator, to determine the policies he is to execute and to see that those policies are carried out; otherwise inefficiency and disaster will come soon or late—generally soon. True as all this is, it is no argument against adopting the best possible machinery of government yet devised—and this, for the city of today, provides for a chief engineer who goes under the name of city manager, whether he be an engineer in fact or merely in executive efficiency.

Specifying Concrete Proportions

IN THE discussion of the Progress Report of the Joint Committee on Concrete and Reinforced Concrete before the American Society of Civil Engineers on Dec. 7 and 8 no subject will receive more attention than the alternate provisions for proportioning. That clause which requires concrete of a given strength and workability and permits the contractor to produce such concrete as he pleases will be especially attacked by the contracting fraternity as unfair and unworkable, or at least tending toward an added expense without compensating improvements in quality. There is a fair question whether the committee has not gone ahead of the state of the art in this clause.

The technic of concrete manufacture has progressed remarkably in the past few years. Cement has been improved and standardized, aggregate selection and grading have approached a scientific basis, proportioning is no longer by rule-of-thumb and mixing and placing are regulated by proved rules. The variations in strength from batch to batch of the best concrete are measurably less than they were a decade ago in some of those structures whose present appearance is beginning to worry engineers. Indeed on some recent jobs where most attention has been paid to the production of the concrete, predicted strengths have been reached with

startling regularity. Study and experimentation are beginning to show in the improvement of the uniformity of the product.

With all this, however, concrete must continue to be a field made product, with all the deficiencies that involves. Its very formation is a chemical action that is not too well understood, unknown factors still affect its strength and the human element, always uncertain, enters largely into its makeup. In spite, therefore, of the great mprovements in the art of making concrete it is hardly fair for the engineer to require the contractor to take all of the responsibility for the strength of the concrete, unless he is prepared to make that required strength far enough below what he may reasonably expect as an average to take care of the inevitable variations that will occur, which obviously would be uneconomical.

Two practical questions also suggest themselves. Is the individual specimen test a complete indication of the strength of the mass and what is to be done about the concrete in the structure the test pieces for which show a strength deficiency at the end of say a 28-day period? It is well known that most concrete cut from structures shows a higher strength than the test pieces poured of the same concrete simultaneously with the placing. Different conditions of curing, the added pressure of the superposed concrete in the structure, the blending of successive batches, all have something to do with this. It would hardly be practicable to order the removal of concrete once placed because of a small reduction from the prescribed strength and it would be most difficult to set a limit of tolerance because of the unknown coefficient of superiority of the structural over the test concrete Furthermore, few structures are of such a nature that concrete placed a month ago can be removed today, without wrecking the structure.

The criticized clause, it will be noted, is merely an alternate. The engineer who employs it in a specification is apt to store up for himself a great deal of trouble. In the first place he must give up a great portion of his powers of supervision, for he cannot well say that the contractor must produce concrete of a certain strength and then tell him how he is to get that strength. Therefore any regulations as to proportions, quality of material, amount of water, time of mixing—all of which influence strength—must be left out of the specification. Will the engineer be willing to relinquish so much of his authority? Or to subject himself to the possibility of a high bid on the one hand from the good contractor who wants to take care of all possibilities or of a deficient structure which must be removed if the contract is let to one who is willing to take a chance?

Constructive Progress in New Highway Act

OF GREATER importance than the appropriation of $75,000,000 of government funds for road construction now and next year, as provided for in the Federal-Aid Highway Act which President Harding signed last week, is the assurance of the adoption, by the states, of sounder policies of highway location, financing, construction and maintenance than has existed in the past. To be sure, the additional funds are urgently needed in several of the states where the availability of state money has been contingent upon new federal-aid appropriations. This situation was brought out in several of the replies to *Engineering News-Record's* inquiry among state highway engineers as to policy regarding fall lettings.

Among the outstanding principles of logical highway administration which have been written into the new law are these: The designation of a system of highways comprising 7 per cent of the mileage of each state; the obligation of matching federal money with state funds under the direct control of the state highway department; the recognition of the need for maintenance and the provision of funds therefor; the centralization of control over road construction in the state rather than in its lesser political subdivisions, relief to the so-called public land states, assuring to them a more equitable distribution of federal funds; insistence upon roads of adequate width—18 ft., except in special cases. The establishment of such general principles marks a great forward step in highway administration and, as Senator Townsend has pointed out, precludes the probability of federal appropriations for road construction becoming subject to the "pork-barrel" charges which have been made against the government's river and harbor expenditures.

Perhaps the bitterest fight on any single feature of the new measure centered on the proposal of a federal highway commission to administer the work in place of the Secretary of Agriculture, through the U. S. Bureau of Public Roads. The commission plan was defeated and control will rest with the bureau which, during recent years, has demonstrated its ability to administer the work.

The passage of the bill, too, probably marks the end of the propaganda for a federal-built and maintained "national highway system." The federal-aid plan has come off victorious.

In the apportionment of federal aid to the states the former principle of a division on the basis of population, area, and mileage is followed, the only new feature being the stipulation that no state shall receive less than one-half of 1 per cent of the total funds, which, in the present case, amounts to $365,625. This provision increases the amounts formerly received by four of the smaller states, Delaware, New Hampshire, Rhode Island, and Vermont. The 7-per-cent road system which each state must select is divided into two classes—interstate and intercounty highways. The former comprises three-sevenths of the system and may receieve 60 per cent of the state's allotment of federal aid. The intercounty highways, constituting the remaining four-sevenths of the system selected, will receive the remainder of the state's allotment.

Coming at a time when unemployment is one of the country's pressing problems, the Federal Highway Act offers a substantial measure of relief by making possible the continuation of the highway programs of the states. It has been estimated that federal-aid road construction is giving employment to 250,000 men either directly or in the production and transportation of materials. Without a new distribution of federal funds, many of the state highway departments would have been forced to curtail, or in some cases to halt, their road-construction programs. These contingencies, happily, have been avoided.

The thought should be emphasized, too, that the appropriation allows highway development to proceed without chaotic interruption. In any enterprise as large as our highway-building program continuity of policy and work is necessary if efficiency is to be maintained.

Practical Hints on Operation and Maintenance

Tractor Grading Outfits

THIS article contains suggestions for selecting, operating and maintaining tractor grading equipment. These suggestions are a summary of the best experience of users and manufacturers. The information is of particular value now when the change from teams to tractors is gathering headway. Modern tractor grading outfits are not a collection of odd machines, but a co-ordinated train of machinery and economy can be secured only by exercising skill in selection, operation and maintenance. —EDITOR.

TRACTORS are used in earth moving to haul wagons and cars for transporting excavated materials and to operate excavating machines, like scrapers and graders, which are actuated by traction. The usual forms of tractor grading outfits are (1) tractors and elevating graders in which case wagons move the excavated material (2) tractors and wheel scrapers (3) tractors and blade graders and (4) tractors and special earth-moving appliances such as land levelers and bulldozers. Ordinarily, blade grader outfits are used for light grading or for finishing rough grading which has been done with elevating graders or wheel scrapers. For heavy grading, contractors east and south of Illinois favor wheel scrapers, while north and west they prefer elevating graders. The land leveler is a development of the Far West. It is a large wheel-scraper type of machine originally employed to level land for irrigation but now used generally in grading operations of other kinds. The bulldozer, a scraper blade attached to and pushed by the tractor, is a special device for grading fills. The primary function of all these combination outfits is to move earth.

A secondary use of tractors in grading is to prepare the ground for earth moving. Clearing and grubbing, and, in hard ground, plowing or scarifying, are important tractor operations. Under certain conditions these secondary uses have to be considered very carefully in selecting tractor grading equipment.

SELECTING EQUIPMENT

There are certain considerations in selecting equipment which apply to all grading operations. They may be set down in the form of rules as follows:

1. Select equipment for its general serviceability. This rule applies particularly to tractors. The variety of duties, from stump-pulling to hauling empty wagons, which they have to perform requires all-around efficiency.

2. Standardize in type and make of equipment. This secures uniformity which simplifies operation and maintenance.

3. Select equipment of ample power and strength. Ability to master an occasional particularly steep or slippery or rough grade, or, without help, to do some especially hard digging, is often required.

With these general considerations in mind, the problem of tractor selection is to determine the kind of tractor and the sizes of tractors which are most efficient for earth grading. At best the hauling conditions are difficult. There are loose soil, soft ground, rough and steep roads and, often, little room for turning and maneuvering. Experience indicates that a gasoline tractor with crawler traction, best meets these conditions.

In general the gas engine has the same advantages for tractors that it has for motor trucks. Multiple cylinders give a compact high-power unit. It is self-contained in respect to fuel supply and operates equally well in all positions of the frame resulting from tilting on rough roads.

Crawler tractions, because of their large area of contact with the ground and the succession of gripping treads, give great pulling power in loose soil. Their wide distribution of the load reduces the danger of miring in soft ground. The long flexible treads ride easily over the bumps and depressions of rough excavated earth. The possibility of operating the treads separately, forward or in reverse, enables sharp, quick turns to be made. Their small vertical height keeps the center of gravity close to the ground and permits longitudinal or transverse tilting without dangerous loss of stability.

Two sizes of tractors, 25 and 40 hp., will meet the requirements of most grading operations. In grading, the small tractor—10-hp. to 12 hp.—is frequently a useful supplementary machine. It will handle a plow, one wagon, a small blade grader or a single fresno or wheel scraper. Its proper function is road conditioning and performing light earth moving where the 25-hp. tractor cannot be given full load.

WORKING CAPACITIES

Manufacturers indicate the sizes of their product in different ways but horsepower, based on drawbar pull at a definite road speed, is perhaps the most simple method for the contractor. On this basis, the two sizes of tractors for heavy grading correspond approximately to 25 hp. and 40 hp. at a working speed of 3 miles per hour. The capacities of these sizes, measured in equipment operated, are about as follows:

A 25-hp. tractor will operate two or three self-loading wheel scrapers or an 8- to 10-ft. blade grader or it will haul two 3½- to 4-cu.yd. wagons. The 40-hp. tractor will operate the largest elevating grader on low gear, from 1½ to 2 miles per hour, and in some work, including casting on direct, on direct drive at 3 miles per hour. It will handle six self-loading wheel scrapers or a 12-ft. blade grader, or, sometimes, two 8-ft. graders. On low gear both sizes will handle their loads on grades up to 30 per cent. Either will make a complete turn within an ordinary roadway.

In selecting grading equipment—graders, scrapers and wagons—it is best to choose machines which are especially designed for tractor operation. Ordinarily, two or more machines are hauled in train. Therefore, special couplings, stronger draft gear and a stronger running gear as a whole, are required. Tractor operation is more intense than team operation, that is, the speed is faster and the machines are kept more steadily

at hard work. Equipment designed for team operation, and wagons particularly, ordinarily must be provided with supplemental draft gear to be safely operated, especially in train, by tractors.

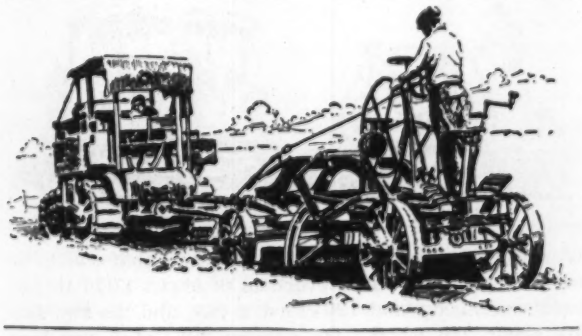
Tractor grading equipment is usually installed by the manufacturer. A service man sets up the machine and puts it in operation. With a trained operator to receive the equipment there are no difficulties in installation.

The factors chiefly to be considered in tractor operation are: Skilled operators; speed of operation, road conditioning, crew distribution, overloading and job planning.

The fundamental requirement for success in operating tractors for grading is trained operators. Economy in wages should not tempt the contractor to employ untrained men. The trained driver will secure enough better service from his tractor and reduce repairs enough to make his higher wages an economy. He will do this by intelligently alternating speed and tractive power to suit the conditions, by pure skill in driving, by keeping his machine tuned up and by anticipating replacements due to wear and making them before a breakdown stops operation.

Speed of operation is a function of the working conditions. For example, if all the equipment including wagons is operated by tractors it is possible to maintain a higher normal rate of travel than where the wagons are hauled by teams. The speed naturally also varies with the character of the roads and with the loads. Tractors of the latest model are usually equipped with three speeds and optional combinations can be provided. A 40-hp. tractor has normally 1½, 3 and 5 miles per hour gear speeds but to meet special conditions a low gear of from 1½ to 2 miles and a direct drive of 2½ miles per hour are available. Older models generally had lower speeds, as 1½ miles per hour on low gear and 2 miles per hour on direct drive.

In actual operations the speeds are alternated as the load demands, as is indicated by the accompanying dynamometer graph of a typical wheel-scraper operation. In this instance a 25-hp. tractor was operating a train of three 4-wheel 1-cu.yd. scrapers in a medium damp clay soil. As indicated, the scrapers are loaded one at a time at low gear, or 1½ miles per hour. Then the tractor is shifted to direct drive, 3 miles per hour, which is maintained while the loads are hauled to the dump. With the scrapers unloaded the speed is changed to high gear, about 5 miles per hour, for the return trip. The lower line of the diagram shows the drawbar pull at all points of the haul. The time required is indicated by the upper line of the diagram. In operating other kinds of excavators, the diagram of drawbar pull will be different than that shown, but in all cases there is alternation of the speed with the load and here is where the skill of the operator assists in keeping the efficiency high.

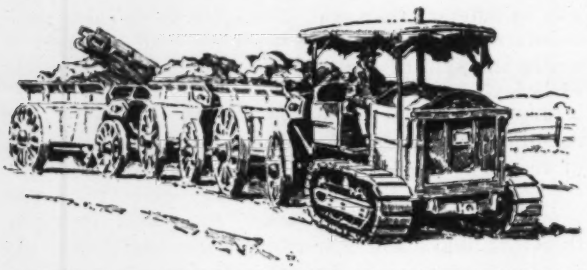


Neglect to keep the haulageway in reasonably good condition results in loss of work and increases the wear of tractors. Crawler tractions have a surprising ability to negotiate bad roads but they exert their best power and speed on good roads. Road conditioning is, therefore, important in tractor grading operations. An occasional smoothing cut with a blade grader and particularly a skimming cut, immediately after rain, to remove the top mud, keeps the road in shape to get speed and pull from the tractor and the cost is small compared with the gain. Good road conditions cut down the road trip time. Fig. 1 shows a round trip time of about 6 min. for about a 1,000-ft. total haul. This is good time over average roads. In continuous operation the lost time factor to be added is about 15 per cent of 1½ hr. per 8-hr. day.

One man operates the tractor under all conditions. Crew distribution, therefore, becomes a real problem only in connection with the grading units, and here choice of practice is called for only in manning wheel-scraper outfits. One scraper man usually loads the train of scrapers, one scraper after another, as each arrives at the point of cut. Some operators advocate a variation of this practice. They employ a separate operator for each scraper. The advantages, they claim, are that the scrapers are kept in better running order; a larger load is taken and a more even cut is made; the time of getting ready for work in the morning is reduced; the work is more active because the men do not become so tired and there is always extra help for an emergency.

Precaution against overloading is important. On whatever speed—low, direct or high—the tractor is operated, there should always be a reasonable margin of reserve power. An advantage of having experienced operators is that they will not fail to notice when the tractor is overloaded. There are circumstances in which the returns from the work performed under overload may be thought to exceed the cost of increased wear and depreciation, but this advantage is always secured at the risk of increased danger of breakage. It is safe to assume that overloading is never really desirable.

More careful planning of the whole operation is required in tractor grading, because all units work faster than in team grading and commonly they work in trains. This calls for more accurate scheduling of movements to prevent interference, particularly if several excavating units are distributing onto the same fill. There should be closer co-ordination of both equipment units and operating processes because interruptions of full output are more costly. Better living and working conditions are required to hold the trained operators who replace the teamsters and roustabouts of a team outfit.



On the other hand, the crews, and the accommodations and supplies for teams, are reduced, and generally the job housing and living problem is simplified.

Maintenance begins with the careful inspection of the tractor when it is received. *Inspection thereafter should be made at stated intervals as daily, weekly and monthly.* These inspections have two purposes, one is to determine the condition of the machine in respect to wear and needed replacement and the other is to perform the work required periodically to keep it in good operating condition. It is in this periodical inspection and constant maintenance that the trained operator demonstrates his value. With an outfit of five to seven tractors a high class mechanic, in addition to the operator, is a profitable investment.

Special provisions for making major repairs, beyond replacements, are not necessary except possibly in isolated or very large plant operations. Ordinarily also, a large stock of spare parts is not necessary. Large manufacturers of tractors and grading equipment provide service stations at most centers of tractor operations from which replacement parts can be secured in a short time and good maintenance inspection can anticipate needed renewals in ample time to have the parts on hand. Standardized equipment considerably simplifies the problem of replacements.

Depreciation and Plant Requirements

Different contractors use different methods of estimating the working life of a tractor and for computing its depreciation. Much depends upon the character of the work, the character of the operation and maintenance, and contingencies which can be classified as pure accidents. Tractors are better built now than ever before, and based upon the performance of earlier built machines, it is safe to assume that a 40-hp. tractor will have a life of 1,000 working days, and at the end of that time, through reasonable care and prompt replacements, the tractor will still be capable of some further service.

Grading equipment, ordinarily assumed to have a depreciation of from 20 to 33⅓ per cent, will have a greater depreciation if operated by tractors. Manufacturers of road machinery are, however, constantly strengthening their equipment to meet the extra demands of tractor operation and this, of course, means longer life and less depreciation as time goes on.

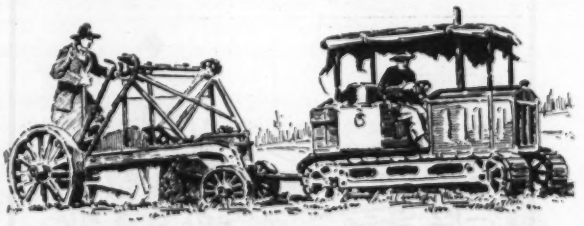
The plant required for a tractor grading job depends upon the volume and character of the materials; the depth and relative locations of cuts and fills; the length of haul, and the period allowed for completion. General directions involve so many qualifications that they are of little service. Two examples of actual operations, both well outfitted as the performances obtained have demonstrated, are therefore presented. One is a mixed team and tractor road grading operation and one is a completely motorized heavy land grading operation. Neither represents the ultimate development in tractor grading, nor the most completely equipped operation, but both represent reasonably good practice and performance.

Wheel Scraper Outfit.—On a five-mile road grading job in Kentucky the contract called for 35,000 cu.yd. of earthwork, twenty concrete culverts and 2½ acres of clearing and grubbing. The route winds among hills with few level stretches and with grades of from 2 to 6 per cent. The soil is limestone clay free from rocks. The free haul is 500 ft. with an overhaul of about 13,000 ft. on 5,000 cu.yd. A combined team and tractor outfit was selected as being most flexible, the teams and slip scrapers being used on short hauls and tractors and 4-wheel scrapers on hauls of 150 ft. and greater. Table I lists the equipment and organization.

The power units consist of two 25-hp. tractors hauling two scrapers each. Six men are employed as operators; two on the tractors and one on each of the four scrapers. On hauls of around 600 ft. one power outfit loads at 360 ft. and the other at 660 ft. from the fill, to prevent delays. On longer hauls this is unnecessary. The road is about 24 ft. wide, which gives ample room for passing at any point and the tractors turn the scrapers easily within this radius, and when necessary can turn within 18 or 20 ft. The teams, besides being used for short hauls, are found particularly useful in smoothing out the road ahead of the wheel scrapers.

TABLE I—EQUIPMENT AND ORGANIZATION FOR TRACTOR GRADING ON HIGHWAY CONSTRUCTION

Equipment	Organization
2 5-ton tractors	1 contractor
1 plow	2 tractor operators
4 four-wheel scrapers	4 scraper operators
1 8-ft. blade grader	4 mule team drivers with teams
4 No. 2 slip scrapers	1 dump man
1 Dodge touring car	1 roustabout
1 motor truck	1 man for clearing right-of-way
1 concrete mixer (1 bag)	1 loader (for teams)
75 ft. of ¾ in. chain, small tools	1 truck driver
	1 concrete mixer foreman
	5 laborers on mixer



Working up and down a 6 per cent grade that was to be cut to 5 per cent, on an overhaul of about 1,300 ft. one outfit averaged about 120 cu.yd. a day, and the two outfits about 240 cu.yd. On another hill, of 5 per cent grade, around 200 cu.yd. was averaged with each outfit, on a 600-ft. haul, and both outfits gave 400 cu.yd. per 10-hr. day.

Elevating Grader Outfit.—Table II gives the tractor-elevating grader performance and cost for a period of nine days on a land development operation requiring heavy grading for streets. This record indicates (1) with a 40-hp. tractor hauling the largest size elevating grader, the maximum volume of dirt can be cut per day even if the work is on steep grades; (2) with several 25-hp. tractors each hauling two 3½- or 4-yd. dump wagons, the maximum output of the grader can be

TABLE II—TRACTOR ELEVATING GRADER COST AND PERFORMANCE ON A LAND GRADING JOB

	Quantities			Costs—Total	Costs—Per Yd.
Total yards dirt removed	7,595				
Distance hauled—ft.	1,600				
Distance hauled—miles	.303				
Total yards—miles	2,300				
Total hours on field	79	15%			
Total hours actually worked	63				
Yards per hour on field	96.2				
Yards per hr. actual working time	120				
Yards—miles per hr. on field	2.91				
Yards—miles per hr. actual working time	3.65				
Gal. gasoline for hauling	945	@	.25 per gal	$236.25	$.0310
Gal. gasoline on elevating grader	334			83.50	.0110
Total gas used	1,279			319.75	.0420
Motor oil for hauling	18		@ 1.10 per gal.	19.80	.0026
Motor oil for grader	16			17.60	.0023
Motor oil for total	34			37.40	.0049
Trans. oil for hauling	6.75			7.43	.0010
Trans. oil for grader	4			4.40	.0006
Trans oil total	10.75			11.83	.0016
Grease used for hauling—lb.	158	@	.10 per lb.	15.80	.0021
Grease used for grader—lb.	70			7.00	.0009
Grease used, total	228			22.80	.0030
Hauling operators	4	@	$35 per wk.	210.00	.0276
Grader tractor operator	1	@	35 per wk.	52.50	.0068
Dump	1	@	35 per wk.	52.50	.0068
Dump men	5	@	3.75 per day	169.00	.0222
Foreman	1	@	40.00 per wk.	60.00	.0079
Wagon repair man	1	@	35.00 per wk.	52.50	.0068
Grader operator	1	@	4.00 per day	36.00	.0047
Grader operator helper	1	@	3.75 per day	33.75	.0045
Freight one way*				350.00	.0460
Ford car*	1 rented	@	14c. per mi.	175.00	.0231
Camp*	1 rented tent			150.00	.0198
Board	15	@	$1 per day	135.00	.0178
Depreciation for 9 days on 1—10 tractor @ 25% per annum based on 200 working days per year				73.50	.0097
Depreciation for 9 days on five-ton tractors @ 25% per annum based on 200 working days per year				240.00	.0316
Depreciation on grader at $1,900 cost price @ 20% per annum				17.00	.0022
Interest for 9 days on investment of $25,400 @ 8% per annum				50.00	.0066
Total cost				$2,247.78	$.295
Hauling cost only				$1,450.78	$.1920
Elevating grader costs				$632.50	$.083

* The propriety of these charges is doubtful—the camp and Ford car are exhibition expenses and the total freight should not be charged against nine days' operation.

Report on Large Power Development at Umatilla Rapids

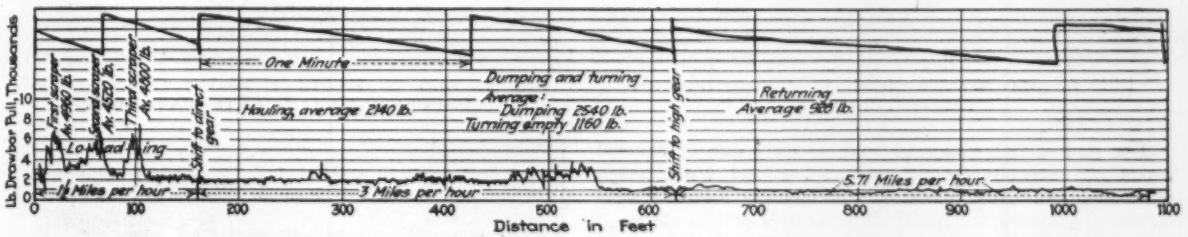
WITH the aid of the states of Washington and Oregon, the Umatilla Rapids Power Site Association of Pendleton, Ore., has recently completed a preliminary report on the plan to develop a large block of power on the Columbia River at Umatilla Rapids, 180 miles east of Portland, Ore. The report was made by the engineering firm of Lewis & Clark, Portland. Some of the chief features of the report are summarized in the following paragraphs:

Both rail and water transportation are available at the site which is within 200 miles of all the principal cities of the Northwest. Markets for the power nearer at hand are suggested in (1) the 270,000 acres of arid land within 45 miles of the site which could be irrigated by pumping, (2) the manufacture of nitrates and phosphates for use as fertilizer and (3) railway electrification.

If private capital cannot be interested in the project before the passage by Congress of the McNary bill, it is hoped that when the bill has been passed, the U. S. Reclamation Service will undertake the Umatilla Rapids development.

Foundation conditions are believed to be satisfactory. At low water bedrock is exposed or is visible for the entire length of the proposed dam except in a narrow section which is approximately 30 ft. deep. It is proposed to construct a 30-ft. dam with an open spillway 1,800 ft. long and a closed spillway 1,400 ft. in length controlled by removable gates, the structure to develop a head of 27 to 33 ft. at all stages of the river. 125,000 continuous horsepower could be developed at low water, 300,000 hp. for eleven months of the year and a total of 500,000 hp. during the irrigation season, the larger power during the irrigation season making it possible to carry the irrigation load without interfering with the sale of power which would be developed for continuous industrial uses.

The cost estimates allow $9,000,000 for the dam, navigation locks, railway relocation, overflowed lands, etc. In addition to that the power development costs would range from about $16,000,000 for 180,000 hp. to $32,000,000 for 500,000 hp. On the basis of construction by the U. S. Reclamation Service with interest at 5 per cent and operating without direct profit the annual cost per horsepower at the switchboard, including all fixed and operating charges, is estimated to be, on the basis of a 300,000 hp. development, $11.40 for primary power, and $6.85 for secondary power. The power cost would be slightly less on the larger power development plan and somewhat more under the minimum development plan.



GRAPH OF DRAW-BAR PULL OF 25-HP. TRACTOR OPERATING THREE FOUR-WHEEL SCRAPERS

moved; (3) that tractors can handle the wagons on the dump, spreading the dirt evenly and making a perfect fill; (4) that a bulldozer attachment consisting of a stout 7-ft. blade mounted on the front end of the 25-hp. tractor reduces time and labor on the dump and in filling in around bridges, culverts, etc., and (5) with a completely motorized outfit, no teams are necessary, the labor of many men is saved, and a volume of work is accomplished which is beyond the capacity of teams.

Train Ferry for the English Channel

A train ferry service between England and France, which was established during the war to facilitate transportation by eliminating the transhipment of freight on each side of the channel, is to be started again for freight service, especially for fruit and vegetables from southern France. Box cars loaded at different points are to be assembled in trains which will run to Calais, the train ferry conveying them to Richborough, where they will be landed and forwarded by rail to London.

New York Develops Double-Slab Concrete Roads

Parallel Concrete Slabs Separated by Macadam Give Three-Way Road at Cost of Single Two-Way Slab

RECENT reconstruction of waterbound macadam roads in New York has developed a double-slab concrete road section which automobile and truck drivers are greeting with favor. It is also proving to be a section which stands up under traffic without excessive maintenance charges on the macadam strip which separates the two concrete slabs. In regard to cost, a 24-ft. paved highway is being secured at about the price of a 20-ft. single-slab concrete road. Inspection of a number of sections from Rochester east to Albany and south to Poughkeepsie disclosed in every instance an easy riding road of handsome appearance.

FIG. 1. OLD WATERBOUND MACADAM BEFORE RECONSTRUCTION

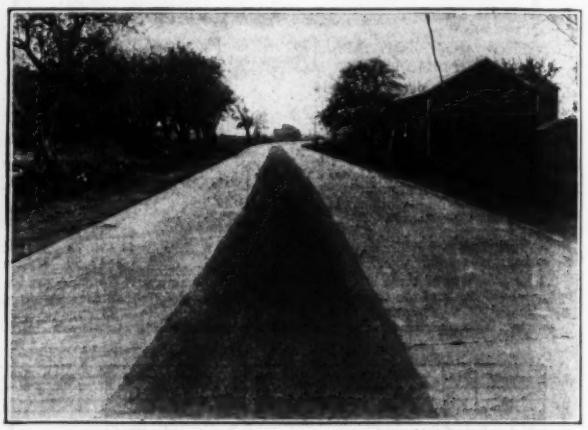


FIG. 2. OLD ROAD, FIG. 1, RECONSTRUCTED WITH DOUBLE-SLAB CONCRETE PAVEMENT

The double-slab concrete road is only one of several types of concrete reconstruction sections with which old macadam, badly damaged by modern motor traffic, is being replaced. Typical illustrations of the old road conditions and the reconstructed highway are given by Figs. 1 and 2. This particular road is near Albany. The cross-section and reinforcement details shown by Fig. 4 are those of a road south of Rhinebeck, N. Y. Examination of this section, with a statement of the modifications employed on other roads, will give a clear idea of the double-slab practice being followed.

In the section shown by Fig. 4, the old macadam is excavated rather deeply and out to the ditch edges. The center strip of macadam is new construction in its entirety. It is 6 ft. wide and the side slabs are 9 ft. wide; these widths are now standard, but some of the older improvements have 8-ft. and 8½-ft. concrete slabs which have proved somewhat too narrow.

Returning to the excavation, the fact to be remembered is that the operation is always one of reconstruction, and to provide an emplacement for the concrete slabs and to build up the separating macadam are different problems in nearly every case. Where the old macadam is narrow, the sub-base has to be extended with new broken stone or slag. Often the concrete slabs are placed virtually on top of the old road, which is merely scarified and the sharp crown flattened by shifting the excess material to the edges. In other instances, emplacements for the slabs are excavated and the center strip is left undisturbed and is merely surfaced with macadam.

The concrete slabs are invariably reinforced, but practice in designing reinforcement varies somewhat with the preferences of the different division engineers. Two broad types, mesh reinforcement and bar reinforcement, are employed and the general character of each is fairly indicated by Fig. 4. Practice in mesh reinforcing ranges from 32 lb. to 60 lb. per square. When bar reinforcement is employed it seldom is lighter than 60 lb. A distinctive feature of this reinforcement is the bent bars placed at the four corners of each 33-ft. slab. These are ½ or ⅝ in. bars 8 or 10 ft. long bent at a 90° angle at the center and laid directly on the wires or bars.

To keep a way open for traffic, one slab at a time is constructed. This is required by the specifications. No more than one half of the road can be obstructed by plant or operations. Ordinarily the full width is scarified and regraded; then one slab is built; then the second slab and finally the center strip of macadam. A typical construction outfit is shown by Fig. 3. On work inspected near Rochester, N. Y., a slab 8½ ft. wide, 6 in. and 8½ in. thick, was being completed at an average rate of 450 ft. a day with a gang of 18 to 20 men, charging with wheelbarrows and finishing with strikeboard,

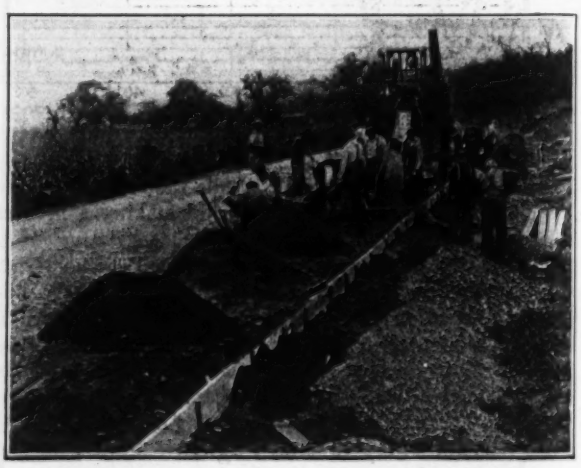


FIG. 3. CONSTRUCTION OUTFIT FOR DOUBLE-SLAB CONCRETE ROAD

roller and belt. The bidding price for 0.8 miles was $22,600, or $28,250 a mile. In another division the bidding price for 1½ miles of 9 — 6 — 9 ft. road was $54,000 or $36,000 a mile.

Recapitulated briefly, the advantages of the double-slab design are: It leaves one half of the road clear for traffic during construction; it gives a wide hard road at no greater cost than a narrower single slab design; it provides distinct routes for right and left traffic and thus contributes toward safety of travel; it is smooth riding and attractive in appearance. It's disadvantages are that the narrow slabs concentrate wear and the penetration macadam separating strip requires considerable maintenance.

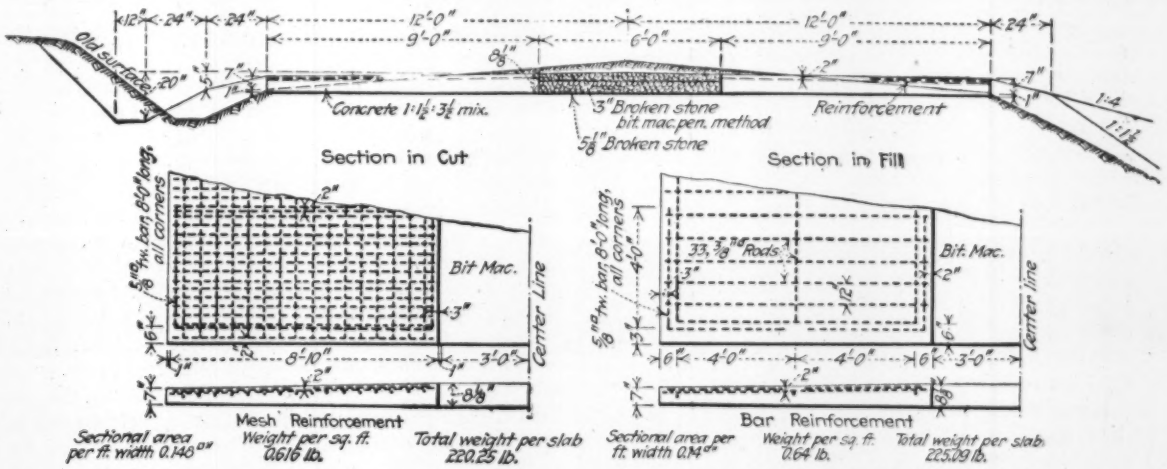


FIG. 4. CROSS-SECTION AND REINFORCEMENT DETAILS OF DOUBLE-SLAB CONCRETE ROAD

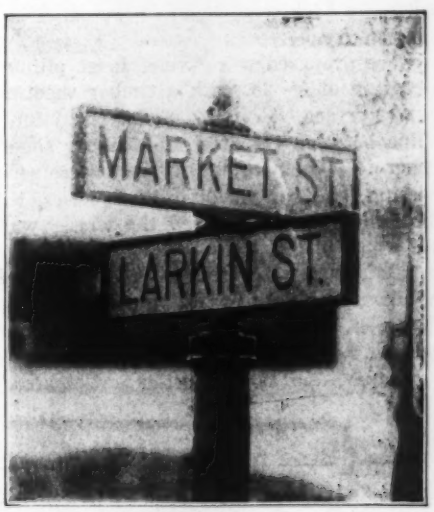
St. Louis Suburban and Rapid Transit Plans

A downtown suburban terminal station for steam railways at St. Louis, Mo., and a combined elevated and subway rapid-transit line for street and interurban electric cars have been proposed by the Department of Public Utilities in order to meet the needs of suburban and local traffic. The union station is distant from the business district and the report states that its main-line traffic is so heavy as to cause suburban trains to be held outside frequently for 10 or 15 minutes before tracks are available. A 16-track station at the southeast corner of Market and Twelfth Sts. is proposed, having its floor 17 ft. below street level. Increased suburban train service is recommended, as well as a belt line service around the city and connection with East St. Louis, as the heavy traffic with the latter city is now accommodated mainly by street and interurban electric lines.

For the rapid transit electric service it is proposed that the Hodiamont line, which has a private right-of-way, should be elevated on a solid fill between concrete retaining walls from Maple Ave. to Spring Ave. At the latter point the line would pass into a subway ending in a loop under Lucas, Morgan and Sixth streets and Broadway. Both suburban and interurban lines could use this route, the interurban cars making only few stops. These improvements in local traffic accommodation are outlined in a report by James A. Hooke, director, and Charles S. Butts, engineer, of the Department of Public Utilities.

New Street Signs for San Francisco Cost $18 in Place

SAN FRANCISCO has adopted a new standard street sign, installation of which is to begin at once. The first signs are being put in in the downtown section and the work is to be continued toward the outlying districts. The type selected, as shown in the accompanying picture, consists of two metal plates set at right angles and fixed to a 3-in. standard pipe support 9 ft. above ground. The bottom of the pipe is imbedded in concrete foundation, and is set 30 to 36 in. back from the face of the curb on the extension of the property line. The first installation will consist of one sign on each street intersection. Later a second sign on the corner diagonally across, is to be added.



NEW SAN FRANCISCO STREET SIGN

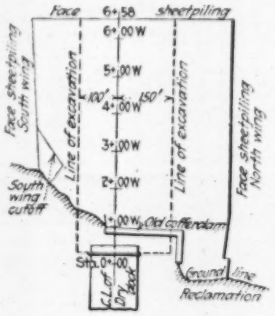
The name plates are 5 x 22 in., made of 16 gage galvanized iron with 3-in. letters milled in the plate. The plates are surrounded by ½ x 1-in. iron channels. Both plates and frames are finished in baked enamel, the lettering and border being of a dark blue color and the background lemon yellow. Posts are painted black 6 ft. from the ground and the remainder of the post is yellow to match the frames. The cost of each sign erected and painted is approximately $18.

Building a Sheet Pile Cofferdam in a 28-ft. Tide

Trestle With Timber Sheeting Used in Construction of Courtney Bay Dry Dock at St. John, New Brunswick

By H. E. Huestis
Engineer, Quebec, Canada

In connection with the 1,150-ft. dry dock being constructed at Courtney Bay, St. John, New Brunswick, under the direction of the St. John Dry Dock & Ship Building Co., it was necessary to excavate an entrance channel 250 ft. wide and approximately 500 ft. long, or to such a distance from the return walls of the dock as to remove all rock to an elevation of — 32, or 32 ft. below low water. There is a tide of nearly 30 ft. here so the cofferdam offered considerable difficulty.

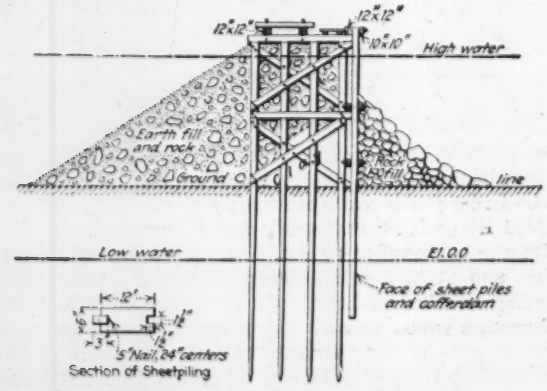


PLAN SHOWING COFFERDAM FOR COURTNEY BAY DRY DOCK

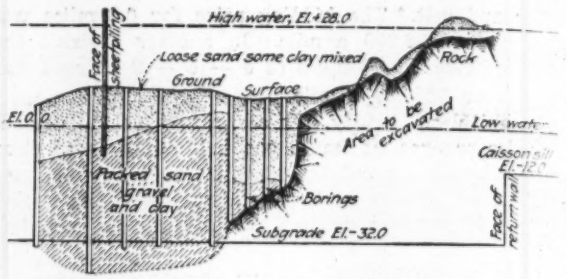
The Bedford Construction Co., at the time, July, 1919, were excavating the prism of the dock, and associated with James B. Craven, New York, took a further contract to remove the material in the entrance channel. This material was estimated to be 140,000 cu.yd. of rock and 110,000 cu.yd. of overlying sand, clay, etc., and as the excavation was a continuation of the dock, seaward or westerly, although at a 12-ft. lower level, it was decided that by the erection of a cofferdam, the material could be removed by steam shovels in the dry.

Plans were prepared using steel sheet piling driven to an elevation of — 33, with a timber sheeting from the ground surface, + 10 to + 32, the joint, at the ground line between the steel and timber sheeting, to be of concrete. On account of the excessive cost of steel sheeting, and for various other causes, this plan was not deemed practicable and the writer was asked to submit other plans.

Two sets of plans were prepared and submitted. One consisted of a double row of timber sheeting, with puddle between, and the other, a single sheeting driven on the outside face of a trestle. As the latter was some $70,000 cheaper, and as the writer anticipated no appreciable leakage from the ground surface to high-water mark, the company decided on the cheaper one.



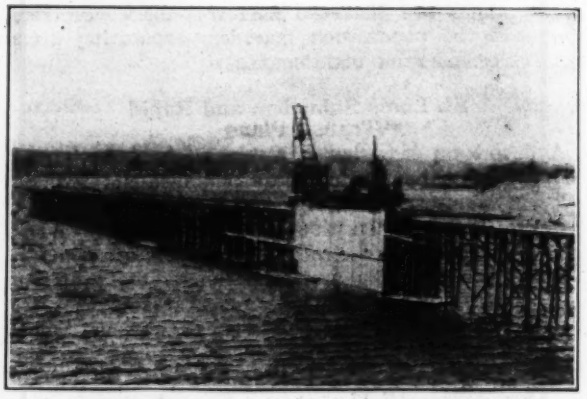
DETAIL OF COFFERDAM FRAMING



SECTION SHOWING MATERIAL OVERLYING ROCK

A most complete set of borings, every 25 ft. over the whole area and to a distance of 900 ft. west from the dock return walls, taken by the Department of Public Works, showed a stratum of clay varying from 5 to 15 ft., overlying and practically following the dip of the rock and although loose sand and gravel was shown underneath this clay stratum, yet at Sta. 9 + 00 west the clay bed dipped to El. — 33.

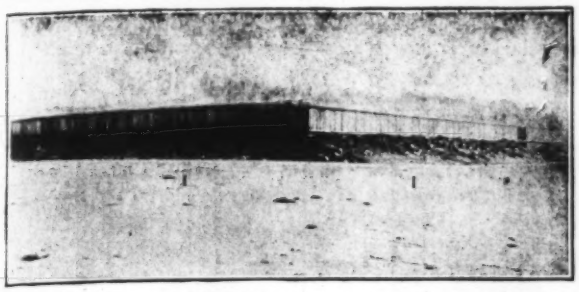
Due to this condition, the writer believed that it would not be necessary to drive sheeting to El. — 32, the level to which the rock should be excavated, but that timber sheeting driven to just penetrate but not pierce the clay bed, and the exercising of the company's right, by a clause in their contract, whereby the dredges could not work within Sta. 12 + 00, would thus keep the clay stratum unbroken, and acting as an impervious blanket, permit steam shovels to take out the material in the dry. The actual conditions worked out as anticipated.



TRESTLE CONSTRUCTED; DRIVING SHEETING ON FACE

The maximum high water at Courtney Bay is + 28.4 the average being + 24, and as the ground surface elevation of the entrance channel is about + 10, twice a day this flat is dry, which facilitated both the erection of the cofferdam and the subsequent dewatering and pumping.

A four pile driven trestle, bents 10 ft. c. to c. was erected, at an average distance of 150 ft. outside the area to be excavated, to which were bolted three double rows of 10 x 10 wales, between which was driven 6 x 10, 12 and 14-in. tongue and grooved British Columbia fir, in lengths varying from 34 to 44 ft. To save timber, which costs from $65 to $85 per thousand ft. b.m., each piece had two grooves, 1½ x 1½ in., and before



NORTHWEST CORNER AT LOW WATER, SHOWING OPENING AT RIGHT

driving, a splice 3 x 1½ in. was nailed in one groove, thus forming the tongue.

Each sheet pile was pointed at the end, and by means of a screw jack, clamped to a pair of wales, it was forced into its companion tongue. Driven by a steam pile hammer to the desired distance, this gave a practically watertight joint. The average penetration was 16 ft., the cutoff being made at El. + 32, which was considered high enough to take care of waves or wind spray.

The work on the trestle was commenced in August, 1919, and sheeting completed at the end of the following November. Previous to the completion, an opening 20 ft. wide was made in the face, to take care of the rise and fall of tide, and before closure a 15-in. pipe and valve were installed, to let out at low water any water that might make during tides.

To add to the stability of the cofferdam, material was dumped inside and outside the face of the sheeting. Clay was to be used, but having in view the experience of the Boston cofferdam, clay was first tried out on the approach trestle, with the result that with the rise and fall of the tide, the clay sloughed to such an extent, that full bents were carried away. Clay was accordingly dumped around the toe only, and the balance of the fill was made up with rock and overburden. In all some 35,000 cu.yd. of rock and 42,000 cu.yd. of clay and overburden were placed around the cofferdam.

Closure was made at the end of December, and with the exception of the southeast corner, where loose rock was struck, the cofferdam was a complete success.

As there was no immediate need of the cofferdam during the winter months, owing to the fact that the 15-in. pipe, assisted at times by an 8-in. pump, could cope with all leakage, nothing further was done until June, 1920.

In the meantime it was learned that the loose rock at the southeast corner was the result of an exhibition shot, touched off by the Honorable Minister of Public Works, at the inauguration of the St. John dry dock, some years previous. It was shot but never moved, and being afterwards filled in, gave no indication of what was actually struck. Exhibition shots are "no bon."

In June by finding solid rock in the southeast corner, and trenching to follow it, a cutoff was built and apart from some water which still came in at high water, no further trouble was experienced. An 8-in. pump working from 8 to 12 hours a day took care of all the water both on the ground surface level and the level of the pit excavation.

INSIDE VIEW BEFORE EXCAVATION COMMENCED

The first big shot in the submarine area was May 12 and by December, 1920, some 125,000 cu.yd. of rock and 80,000 cu.yd. of overlying material had been removed. It was quite feasible to remove the balance, but as the St. John Dry Dock Co. had not completed all preparations for the construction of their caisson, as an extra precaution it was mutually agreed that this material should be left. At the present time these caisson walls are being constructed by the St. John Dry Dock Co. and it is to be hoped that they will be expeditiously carried out, as the cofferdam was not intended for more than two seasons.

The conditions at Courtney Bay were unique in their way, inasmuch as steam shovels were excavating below the

INSIDE THE COFFERDAM: SHOVELS WORKING AT EL.-32

bottom of the sheeting, or under an extreme head of 62 ft., at high water, and this stratum of clay acted in every sense as a lower level cofferdam. There was absolutely no indication of water coming in at the face of the cut.

In addition to acting as a cofferdam, the trestle was used as a means of receiving all freight and coal, and also as an approach to a dump for the shipways embankment, over 200,000 cu.yd. of material from the prism of the dock being carried over it.

The total cost of material, construction and maintenance of the cofferdam, during excavation, was a little over $1 per cu.yd. of submarine rock removed.

Locomotive Track Scale Shows Load on Each Wheel

Platform of 450-Ton Scale Carries Portable 25-Ton Scales Which Register Weight on Individual Wheels

By Carl C. Bailey
Baldwin Locomotive Works, Philadelphia, Pa.

A NEW LOCOMOTIVE weighing plant of high load capacity at the Baldwin Locomotive Works, Eddystone, Pa., has the special feature of a scale platform wide enough to carry portable scales for taking the load on each individual wheel. The large scale is composed of six sections, each designed for a theoretical concentrated load of 150 tons, making a total of 900 tons, with a working capacity of 450 tons. Fig. 1 shows an engine on the scale platform, with the individual scales adjusted to its wheels. Fig. 2 is a cross-section of the plant.

Weighing locomotives at the Baldwin works has been done hitherto by taking the total weight on a track

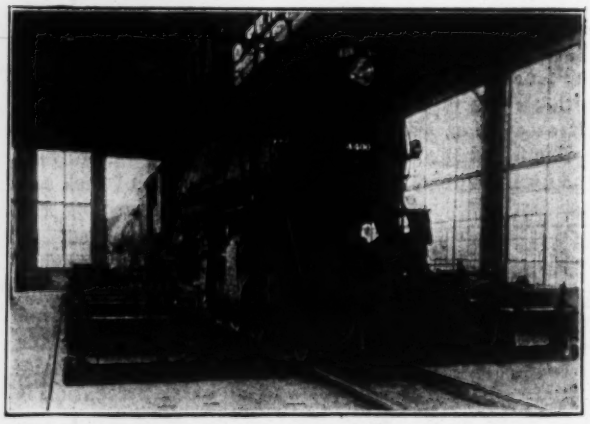


FIG. 1. LOCOMOTIVE ON TRACK SCALE WITH INDIVIDUAL SCALES UNDER THE WHEELS

scale and then moving the engine to a track having concrete foundations wide enough to allow of placing an individual scale under each wheel. It was difficult, however, to obtain any degree of accuracy in comparing the total weight on the platform with the sum of the weights of the individual scales. After investigations as to the weight of the largest locomotive which it would be practical to build, it was decided to construct a scale of 450 tons working capacity and with a platform of such width as to permit placing individual scales under the wheels. In this way all weights would be determined with the engine in one position.

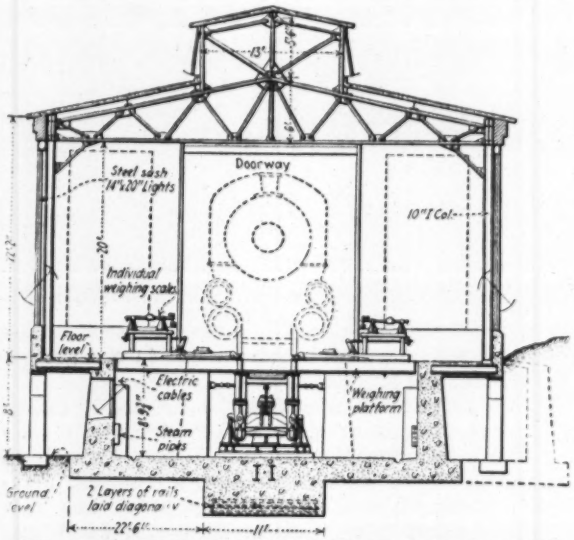


FIG. 2. SECTION OF LOCOMOTIVE WEIGHING PLANT

At the new plant, the scale platform is 100 x 27½ ft., and the 110-ft. pit is extended 5 ft. under the floor at each end. This end arrangement is to enable the load to pass over the main bearing pivots of the end section before it rests on the scale proper, thus alleviating the impact on the knife edges, increasing the life of the mechanism and resulting in more accurate weight. The design and arrangement of parts are shown in Fig. 3.

In considering the stresses recommended by the scale specifications of the American Railway Association and the U. S. Bureau of Standards, it was found that under maximum loading the longer extension levers, if designed by the given fiber stresses for the tension side in transverse bending, would deflect much more than permissible for this class of work. By designing the longer levers with regard to deflection as well as fiber stress, these latter stresses were much reduced. To conform to these specifications, the designers were confronted with the problems of producing a knife edge in the main levers which would be of sufficient length to take a loading not to exceed 7,000 lb. per lineal inch, and of supporting it in a substantial manner to secure an even distribution of the load.

These knife edges, 22 in. long, are made of a special oil-hardened alloy steel which has an elastic limit of not less than 160,000 lb. and a tensile strength of not less than 200,000 lb. All other knife edges and bearing steel meet the same requirements. The entire surfaces of all pivots and bearings are machined, hardened and ground and set in machined ways. Bearing steels for fulcrum stands are set in removable blocks. The knife edges are so constructed as to have continuous contact with their bearings and the only bow loops are those for counter-balancing or back-balancing the weigh beam.

Each of the twelve cast steel main levers weighs approximately 1,075 lb. and has one end resting upon a fulcrum stand, the other end being suspended by a stirrup. From these levers the massive cast steel yokes that carry the platform are suspended by two heavy machine steel stirrups, as shown by Fig. 3. The bedplate supporting the main and the extension lever fulcrum stands is a single casting secured to the foundation by independent anchor bolts in order to facilitate accuracy in leveling up on a concrete foundation. There

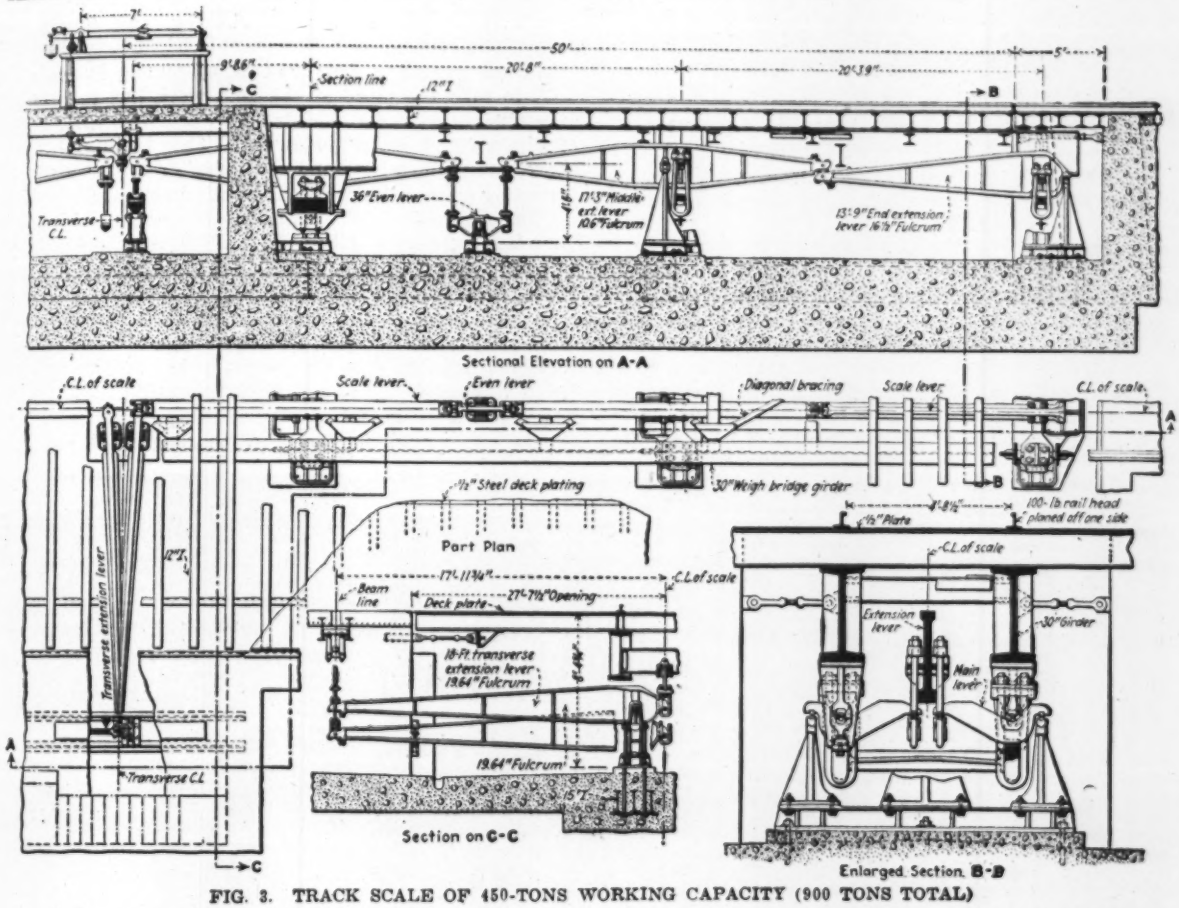


FIG. 3. TRACK SCALE OF 450-TONS WORKING CAPACITY (900 TONS TOTAL)

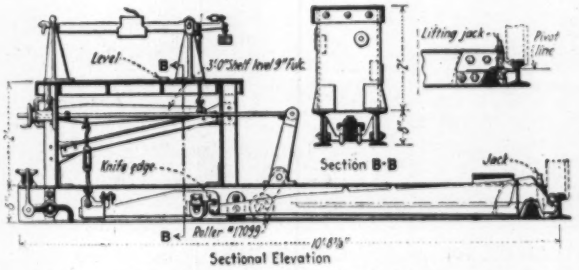


FIG. 4. PORTABLE SCALE FOR TAKING LOADS ON INDIVIDUAL WHEELS

are ten bedplates; one for each scale section, two for the even levers that connect the inner sections and two for the transverse extension levers. These last four are of cast steel because the stress is practically direct tension. All contact points of metal against metal are machine finished.

The connection between the middle extension lever and the transverse extension, shown in Fig. 3, is accomplished by means of two machine steel stirrups passing over bearing blocks which engage the butt pivot of the transverse lever and the end pivot of the middle extension lever. These stirrups are then connected by a 2-in. plate which permits vertical adjustment. The connection between the middle extension lever and the 3-ft. even lever consists of two similar stirrups that pass over the bearing blocks which engage the end pivot of the middle extension lever and the end pivot of the even lever. These stirrups are connected by two 1¼-in. plates and two draw bars. To resist the upward pull, the fulcrums of the even levers and extension levers are anchored to the sub-bases by cast-steel inverted stirrups, each held by two 1¼-in. anchor bolts. In the upper part of these stirrups are bearing blocks engaging the fulcrum knife edges.

The connection between the transverse extension lever and the lever under the weigh beam is arranged to permit one lever to be leveled independent of the other, to allow swiveling to match the different angles at which the levers hang and to give vertical adjustment to the levers in unison. In design and manufacture, great care was exercised in locating all pivots practically on the neutral axis of the section, in order to obtain an even distribution of the weights about the pivot line. On the platform scale the weigh beam is graduated by 5,000-lb. increments to 895,000 lb., an auxiliary beam of 5,000 lb. capacity graduated to 50-lb. increments brings up the total capacity to 900,000 lb.

New 785-Mile Trip is Longest Train Run in Britain

The longest British railway run is the new 785-mile 22-hour trip between Penzance at the southwest corner of England and Aberdeen on the northeast coast of Scotland. Through day cars are run, dining cars are attached at convenient times and sleeping cars are attached in the evening. The route is over six different lines and serves a number of important cities. This service is operated daily in each direction.

Sand Box Employed in Teaching Topographic Mapping

University of Illinois Adopts Plan Which Clearly Indicates to Student Interdependence of Various Steps Taken

By W. H. Rayner and J. R. Stubbins
Assistant Professor of Surveying Instructor in Surveying
University of Illinois

ONE of the greatest difficulties which attends instruction in topographic surveying is to secure the proper conception in the student's mind of the interdependence of the various steps to be taken in the execution of such a survey. It was primarily an attempt to meet this difficulty which led to the adoption, at the University of Illinois, of the device to be described herein. This original purpose has been adequately fulfilled, and a number of other advantages have resulted.

FIG. 1. SAND-BOX GIVES VIVID PICTURE OF TOPOGRAPHIC FEATURES

The use of models for instructional purposes and for studying layout schemes of various sorts is common practice and the value of this aid to instruction was fully demonstrated in the late war. Much use was made of the sand-box, the puff-board, and the relief map in the different branches of the service. It is believed, however, that the application of the use of the sand-box to instruction in the design and execution of accurate topographical surveys is new and of peculiar value.

The general features of the scheme may be stated briefly as follows: A landscape which includes the more common topographical features is modeled accurately to scale in the sand-box; a set of field notes for a complete transit-stadia survey of this area, is derived from the sand-box landscape by methods to be explained later; the students are then assembled around the box and each man acts as the recorder of a transit-stadia survey party. The instructor acts as the instrument man, calls off the notes just as they would be called off by a transitman in the field. By proper methods the students reduce these notes for plotting, and, finally the survey is plotted and the map finished according to standard practice. This scheme, of course, is designed not to take the place of the field work but to prepare the student to undertake his field work with greater intelligence and better judgment. This training, therefore, saves much time and results in greatly accelerated learning on the student's part while in the field.

The materials used in the construction of the sand-box landscape are: 1 box, 6 ft. x 8 ft. x 10 in.; ¾ cu.yd. of fine sand; 2 cu.ft. of pulverized shale; 2 sets of symbols for houses, water-tanks, bridges, etc., secured from the U. S. Disciplinary Barracks at Fort Leavenworth, Kan.; sponges for trees, and other symbols as desired.

Some practice may be necessary before the uninitiated will secure good results in modeling, but a high degree of skill is not at all necessary. The sand and shale are placed in the box, thoroughly mixed and moistened. The sand will remain moist for two or three days but all modeling should be done on the first day. The model is constructed according to the general plan selected, care being taken to keep the features and shapes consistent with the scales chosen. It has been found desirable to double the vertical scale so as to give a more impressionistic view of the relief. Perhaps the trees, houses and bridges will not be exactly to scale, but the impression will be very good nevertheless. A good effect for underbrush may be secured by dropping lumps of wet sand on the finished surface. Pieces of sponge stained green make good tree symbols and light-brown plasticene strips may be used for roads, etc. Any degree of elaboration may be used in the embellishment of the model. A view of the box as now in use at the University of Illinois is shown in Fig. 1.

From this point the procedure is as follows: The instructor chooses a purpose for the survey of this area, and for the survey here described it is assumed that a transit tape traverse is best for the horizontal

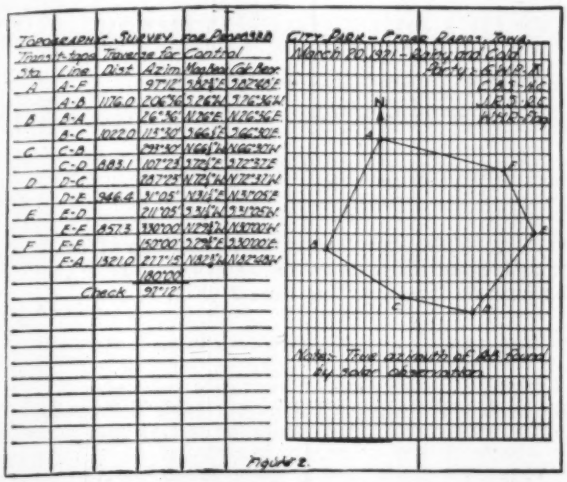

Topographic Survey for Proposed
City Park - Cedar Rapids, Iowa.
March 20, 1921 - Rainy and Cold
Party: E.H.P. A.
Traverse for Control
Sta. Line Dist. Azim. Meridian Calculated
A A-F 97'12" 97°12'E S82°48'E
A-B 1176.0 206°36' 26°36'W S26°36'W
B B-A 26°36' N26°36'E N26°36'E
B-C 1022.0 115°30' 90°66'E S63°30'E
C C-B 295°30' N63°30'W N63°30'W
C-D 883.1 107°25' 37°5'E S72°35'E
D D-C 287°25' N72°35'W N72°35'W
D-E 946.6 31°05' N41°E N30°05'E
E E-D 211°05' 90°41'E S30°05'W
E-F 857.8 330°00' N30°W N30°00'W
F F-E 150°00' 90°E S30°00'E
F-A 1321.0 277°15' N82°E N82°45'W
180°00'
Check 97°12'
Note: True azimuth of AB found by solar observation.
Figure 2.

FIG. 2. HORIZONTAL CONTROL OF SURVEY

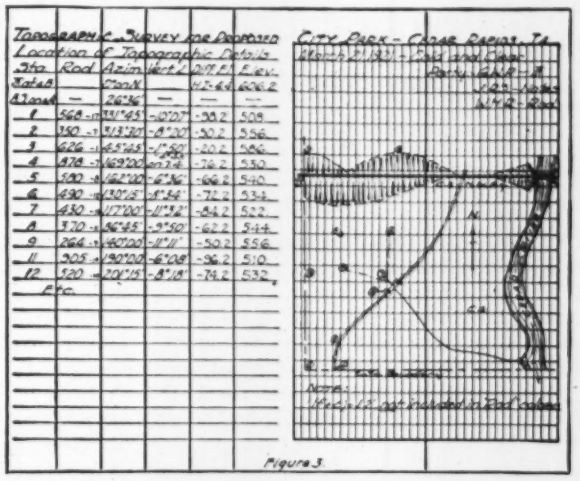


FIG. 3. SAMPLE PAGE OF STADIA NOTES

control. The traverse stations are selected according to good field practice and their locations are marked by small flags, consisting of bits of white cloth glued to toothpicks or matches. The side shots for the location of contour points and details are then selected and marked by small bits of paper on which are printed identification numbers and which are held in place by ordinary pins. Special care is taken to place these points so as to completely control the drainage net and principal ground forms with the fewest possible points.

These points are then located by co-ordinate measurements from the sides of the sand-box and are plotted on the instructor's map, on which the sand-box edges (co-ordinate axes) have previously been plotted to a reduced scale. The scales now in use are as follows: On the sand box the horizontal scale is 1:400, and the vertical scale is 1:200, on the map the scale is 1:2400 and the contour interval is 10 ft.

The elevation of the river bed on the bottom of the box is then assumed and the differences in elevation between it and all traverse and detail points are observed directly on the sand-box by means of an engineer's level and rod. These values are enlarged in the proper ratio and the relative elevations of the points are entered on the instructor's map.

Next the azimuths and lengths of the traverse courses are carefully measured on the instructor's map with a Colby protractor and scale, and the results recorded in good note-book form. These measurements should be made with great care for the accuracy of the students' maps, to be made later, will depend on these notes. The latitudes and departures of the traverse are computed and adjusted if necessary to give a degree of accuracy consistent with the purpose of the survey and scale of the resulting map. This completes the reduction of the horizontal control to notebook form. (Fig. 2.)

The vertical control may be given to the students in the form of a set of differential level notes or if desired the elevations of the traverse stations may be given to the students outright. The side shots for the location of contours, points and details are determined by azimuths and distances, scaled in a manner similar to that used in locating the traverse stations.

These measurements furnish the horizontal distances and differences in elevation of all the detail points and it remains to compute a vertical angle and a rod reading which, if taken in the field, will yield these distances when reduced. This is best done by means of a stadia slide rule. A sample page of stadia notes is shown in Fig. 3, the inclined figures being those which are to be read to the students. The instructor's map is now contoured, finished, traced and used by the instructor to check the students' plotting and sketching.

It is now possible to place before a class of students the project of making a complete topographic survey and map which very closely approximates actual field conditions. They are given only the purpose of the survey. In consultation with the instructor they decide on the scale of map, and contour interval. With these conditions established, they decide on the instruments, methods, checks, allowable errors, personnel and organization of the party for each part of the work. While looking at the landscape model, they imagine a transit set up in the field. The instructor gives the readings as they would be taken in actual work and the class records these notes in proper form. An excellent opportunity is given the instructor at this point to indicate the principles which govern the selection of detail points and to point out the best methods of procedure.

Each student now reduces his notes, plots the points and constructs a map in the usual manner, except that in sketching the contours he has an actual situation before him to interpret, both by means of his plotted points and by inspection of the real configurations of the landscape. Sometimes the students are asked to exchange note-books so that one man plots another man's notes and consequently gains a comprehension of the uselessness of vague notes. The map is inked in colors, using the usual symbols and a report is prepared which approximates the report of a similar survey in the field.

The use of this device is established and justified because it possesses these advantages: (1) The work is independent of field weather conditions; (2) it enables the student to see the relation of each step to the entire project; (3) it enables the student to see the significance of controlling points, and of ridge and valley lines; (4) it gives a clear and comprehensive conception of the factors which govern the choice of instruments, methods, and personnel; (5) it emphasizes the importance of good note-keeping and affords excellent practice in this regard; and (6) it enlists the student's interest quite as much as the out-of-door work.

Practical Use of Excess Sand in Concrete Mixtures

Tests Prove Pit-Run Gravel Suitable for Concrete Pavements—Iowa Practice in Proportioning Mixes of Varying Sand Content

By R. W. Crum
Engineer of Materials and Tests, Iowa Highway Commission, Ames, Iowa.

APPROXIMATELY 187 miles of single-course concrete pavement were constructed in Iowa in 1920 and 1921. In 122 miles of this pavement, unusual concrete mixtures were used; the aggregates contained from 50 to 80 per cent sand instead of the 33 to 40 per cent which is common. To keep the quality constant, additional cement was used in the mixtures rich in sand. Judging from tests made daily during construction, and from observation of pavement in service up to one year, the quality has been consistently maintained although the mixtures range from a 1 : 2 : 3½ by volume to 1 : 2½ : 1 by volume.

In 35.43 miles of road, unscreened pit-run gravel was the aggregate. *The tests show that this road is as good in every way as those in which screened aggregate was used.* If the constituent particles are good and the material is clean, we conclude that, when properly handled, pit-run gravel is suitable for use in paving.

The advantages in the use of pit-run gravels and of mixtures rich in sand have been: First, reduced cost, and, second, ability to carry on projects not otherwise possible. A conservative estimate of the saving in the cost of the two years' work, is $144,000. At least 35 miles of pavement were completed, which would not have been built under other circumstances.

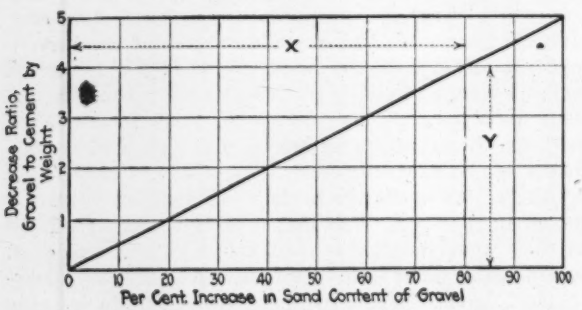


FIG. 1. DIAGRAM FOR PROPORTIONING CONCRETE MIXTURES OF VARYING SAND CONTENT

The method by which mixtures of varying sand content are proportioned, has been worked out by the Engineering Experiment Station of the Iowa State College from the results of some five years of experimental work. This method depends only upon the ratio of sand to total aggregate by weight. In the use of pit-run gravel, field control is very easily maintained since simple determinations of the percentage of sand in the gravel and the weight per cubic foot of the aggregate can be easily and often made.

Figure 1 is the basic diagram for proportioning mixes of varying sand content. To use this diagram the procedure is as follows. First assume a mixture known to be satisfactory, then: (1) Reduce the proportion of the standard mix to the basis of weight. (2) Determine from Fig. 1 the decrease in parts of aggregate corresponding to the increase in the percentage of sand in the aggregate and change the proportions accordingly. The formula for computing item 2 (Fig. 1) is:

$$\tan a = \frac{4.0}{80} = 0.05, \text{ and } y = x \tan a = 0.05\,x$$

Example: Assume that an aggregate containing 42 per cent sand, and weighing 112 lb. per cubic foot, makes a satisfactory concrete in the proportion of 1:4½ loose volume. What proportion should be used in a similar gravel containing 75 per cent of sand and weighing 107 lb. per cubic foot?

Assume that 94 lb. of cement equals 1 cu.ft. Then 1 cu.ft. of cement to 4.5 cu.ft. of aggregate equals 94 lb. cement to 4.5 x 112 lb. gravel, equals 1 lb. cement to $\frac{4.5 \times 112}{94}$. Therefore the proportion by weight is 1 to 5.36.

The increase in the percentage of sand is 33. From the diagram, the corresponding decrease in parts of aggregate is 1.6. Therefore, the proportion to use for the gravel containing 75 per cent of sand should be 1 to (5.36-1.6) or 1 to 3.76.

If it is desired to measure the materials by volume instead of by weight change the above weight relation to a loose volume proportion as follows:

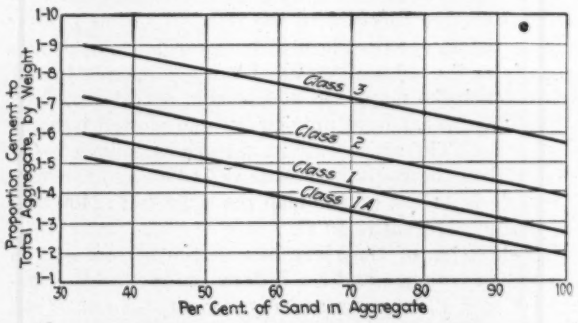


FIG. 2. MIXTURES OF VARYING SAND CONTENT FOR CLASSES OF CONCRETE IN COMMON USE

Weight per cubic foot of cement, 94 lb.; weight per cubic foot of gravel, 107.0 lb.; 1 lb. cement to 3.76 lb. gravel equals 94 lb. cement to 354 lb. gravel, equals $\frac{94}{94}$ cu.ft. cement to $\frac{354}{107}$ cu.ft. gravel, equals 1 to 3.30 by loose volume.

Fig. 2 is a working diagram for several classes of concrete in use by the Iowa Highway Commission. Class IA is the one in present use for single course concrete pavement.

Two 6 x 12-in. cylinders for crushing tests, and two 8 x 8 x 5-in. blocks for wear tests were made each day from concrete going into the roads. These specimens were cured and stored in a manner similar to the conditions of curing in the pavement. At the same time, the cement was removed by washing from a sample of concrete from the same batch, and a sieve analysis was run upon the aggregate. These data represent 46.17 miles of pavement built in 1920, and divided as follows:

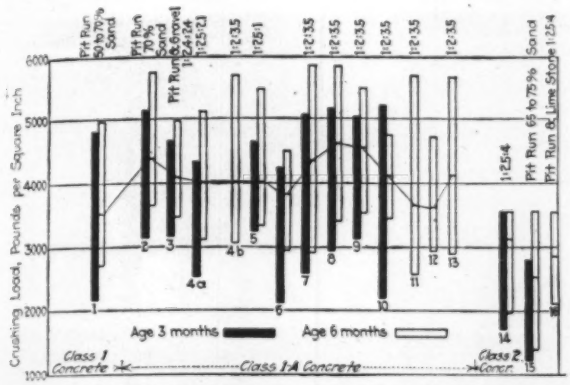


FIG. 3. STRENGTH TESTS OF FIELD SPECIMENS OF PAVEMENT CONCRETE

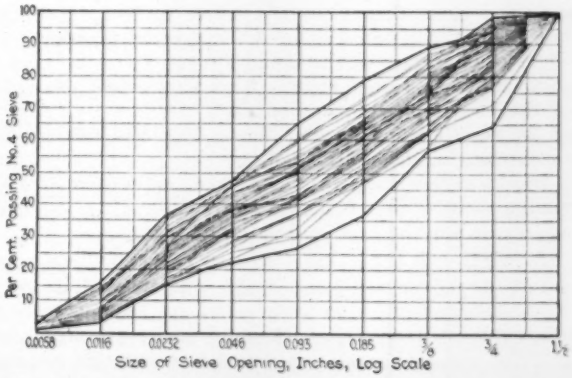


FIG. 4. SIEVE ANALYSIS OF SAMPLES FROM MIXER ON PROJECT 1

Single course concrete, pit-run gravel	5.52 miles
Single course concrete, screened aggregate 50 to 80% sand	8.04 miles
Single course concrete, screened aggregate, 1:2:3.5 by volume	21.81 miles
Base course for brick, pit-run gravel	5.42 miles
Base course for brick, screened aggregate, 1:2:5.4	5.38 miles

It is to be expected of specimens made in this way, under field conditions, that there will be considerable variation in individual results. However, if a considerable number of specimens are used it is reasonable to expect that the average will be representative of the strength of the concrete, and that the variation in the individual results will give some measure of the comparative uniformity on different jobs. Of course many variables enter into the control of strength and uniformity. No attempt has been made to study the effect of the various conditions. We have drawn only one conclusion and we believe that to be substantiated.

We believe that it is entirely possible to design and construct pavements using pit-run gravel, or high ratios of sand to coarse aggregate, equivalent to pavement made from the common arbitrary mixtures such as 1:2:3.5, provided the same standards of supervision and inspection are maintained.

Crushing Tests.—Results of tests at the age of three and six months on concrete single-course pavement are shown by Fig. 3. The three months' specimens were made late in the fall and when studied with respect to weather conditions show a decided tendency toward decrease in strength as the days upon which they were made grew colder. Taking into account the varying conditions as to source of materials and methods of operation it would appear that there is no greater variation in strength between the high sand ratios and the 1:2:3.5 mixes or between screened and unscreened mixes, than there is between any two of the 1:2:3.5 mixes. Project 1 is class 1 concrete and 14, 15 and 16 are base concrete, while all of the others are class 1A concrete (Fig. 2). In view of this difference the average for No. 1 is not inconsistent.

Sieve Analysis.—Other qualities being equal, the principal objection to the use of pit-run gravel has been the fancied lack of uniformity in the resulting concrete. It is true that these experiments show that there is a great opportunity for improvement in the uniformity of concrete mixes, but, it is rather surprising to note that the mixtures of screened aggregates are no better in this respect than pit-run gravel mixtures, and often not so good when the pit-run gravel is handled in the most advantageous manner. Figs. 4, 5 and 6 show the sieve analyses (upon four typical projects) made daily upon samples of concrete from which the cement had been removed by washing. Fig. 4 refers to project No. 1 in Fig. 3 and is the worst example of variation in the pit-run gravel mixes. In this case the material was hauled direct from the pit to the road and strung along the subgrade. This method of handling pit-run gravel is the worst possible and should not be permitted. In order to compensate for the variation in sand content, three different mixes were used on this job.

Fig. 5 refers to project No. 2, a pit-run gravel job in which the material was properly handled. The gravel was piled by the excavating machinery in a large stock pile containing more than 1,000 cu.yd. of material. Gravel taken from this stock pile and measured in industrial railway batch-boxes showed such uniformity of

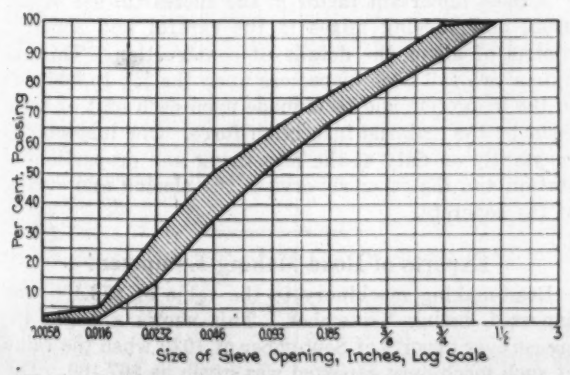


FIG. 5. SIEVE ANALYSIS OF SAMPLES FROM MIXER ON PROJECT 2
Hatched portion is area in which sieve analysis curves fall

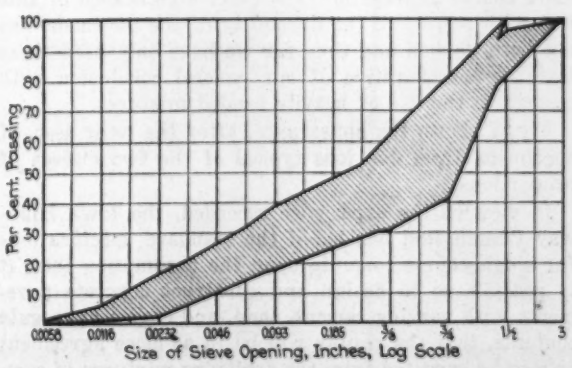


FIG. 6. SIEVE ANALYSIS OF SAMPLES FROM MIXER ON PROJECT 8
Hatched portion is area in which sieve analysis curves fall

the sand content that for the entire project of eleven miles there was no occasion to change the proportions. The sieve analyses on the samples taken from the mixer corroborate this uniformity. This is the best example of the use of pit-run, but is much more nearly typical of the results being secured than is Fig. 4, which refers to obsolete methods of handling.

Fig. 6 refers to project No. 8 and is typical of the results secured with screened aggregates. It is neither the worst nor the best case noted in 1920.

A study of these data further substantiates our opinion that it is possible to make concrete with as uniform composition from unscreened as from screened aggregates. However, all gravel deposits are not suitable for use as unscreened gravel. In practice, before the use of pit-run gravel is authorized, the Highway Commission engineers assure themselves by thorough investigation that the deposit is capable of producing reasonably uniform and high quality material. These 1920 observations with respect to sieve analyses are also corroborated by similar data accumulated in 1921, in the construction of 140 miles of pavement.

TABLE I. WEAR TESTS OF CONCRETE TAKEN FROM PAVEMENT CONSTRUCTED IN 1920

(Age of Specimens about six months)

Project Number	No. Specimens Tested	Wear in Inches	Project Number	No. Specimens Tested	Wear in Inches
1	64	0.40	7	28	0.43
2	22	0.47	8	12	0.43
3	16	0.45	9	18	0.39
4a	26	0.37	10	33	0.42
4b	28	0.31	11	32	0.41
5	41	0.46	12	21	0.39
6	6	0.43			

Wear Tests.—The results of wear tests are given in Table I. The specimens were tested in a Talbot-Jones rattler, according to the method used by the Structural Materials Research Laboratory at Lewis Institute. The result of this test is reported in inches of wear, which is the average depth worn off of the specimen. Inspection of these data corroborates the general conclusion that there is a reasonable uniformity in results on the various jobs. Such a wide variation in conditions is represented that no refined comparisons can be made on the basis of the average depth of wear. Visual examination of the blocks is more illuminating. While the average depth of wear is very nearly the same for the different mixtures, it is seen that those concretes having a high ratio of sand to coarse aggregate, show a much more uniform wear than those concretes containing more coarse aggregate. The exact significance of this test with respect to the durability of the pavement has not been defined and thus far we have only used these tests as corroborative of our general conclusion with respect to the use of heavily sanded mixtures.

Fig. 7 shows the appearance, after the wear test, of specimens from five jobs typical of the two classes of proportions.

In view of the experience recorded, the Iowa Highway Commission has based the standard specifications for single-course concrete upon the assumption that, it is possible so to design and construct concrete pavements with varying cement, sand, and coarse aggregate contents, that the results will be in as close agreement as may be expected from the arbitrary mixtures in common use. Furthermore, the more heavily sanded mixtures have at least two quite important advantages:

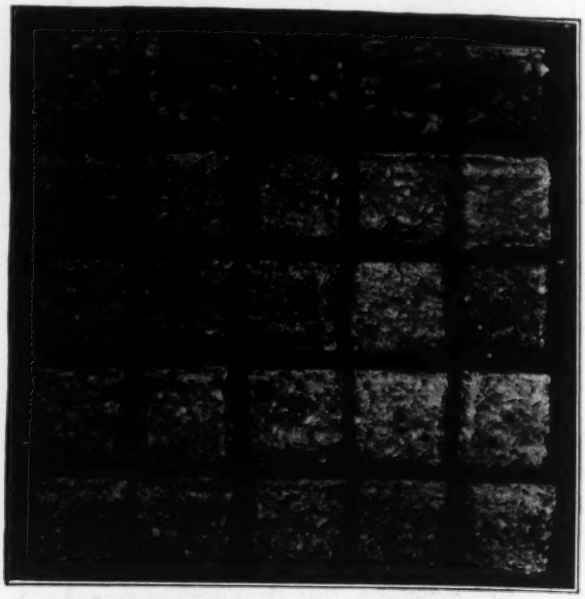


FIG. 7. TYPICAL APPEARANCE OF SPECIMENS SUBJECTED TO TALBOT-JONES WEAR TEST

1. It is quite generally accepted that if the voids in the coarse aggregate are more than filled by the cement and sand mortar, the internal grading of the coarse aggregate will have little effect upon the strength of the concrete. Such being the case with the mixtures under discussion makes it possible to use certain aggregates which might not be suitable for use in the more common mixes.

2. In proportioning mixes of high sand to coarse aggregate ratio, the amount of the cement should be based upon the maximum amount of sand to be expected, then, when the amount of sand at times becomes less, the high ratio of cement to sand will more than compensate for the variation. For instance if the proportion be based upon 70 per cent sand and the percentage of sand falls to 60, the mix would have more cement than the 60 per cent of sand requires, and the variation would not be at the expense of the strength of the concrete. As shown by the sieve analyses, considerable variation is to be expected. Mixes, such as the usual 1:2:4, which are intended just to fill the voids in the coarse aggregate do not provide any such factor of safety and most of the variation is, therefore, more serious.

A most important factor in the successful use of unusual and varying mixes is the careful and accurate control of all of the details of construction. This requires two full time inspectors upon the job in addition to the inspection and tests made upon each unit of shipment by the material inspection force. One inspector is constantly on duty at the measuring and proportioning station and the other supervises the placing and curing of the concrete.

Exports of Road-Making Equipment

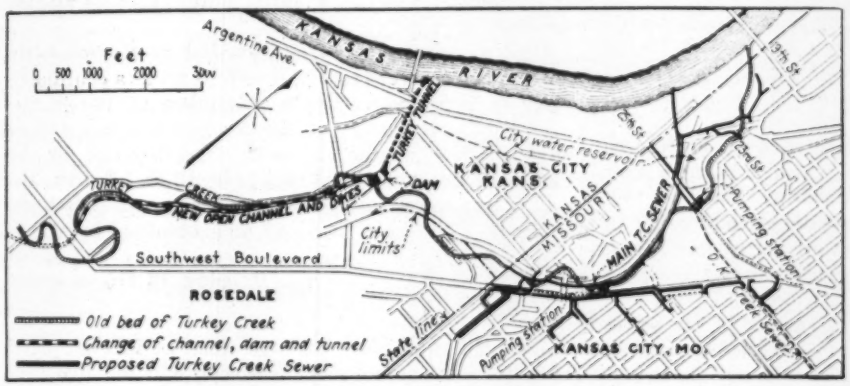
Road-making machinery to the value of $73,108 was exported during September. This shows a slight increase over exports of September of 1920 when the value of such machinery exported was given as $67,160. The figures are those compiled by the Department of Commerce.

Turkey Creek Sewer One of the Largest Yet Built

Relation of Sewer to Other Features, Contractual and Engineering, in Flood Control Problem of Kansas City—Design Data Given of 17 x 18-Ft. Double-Box Section Under Pressure

By Alfred D. Ludlow
Civil Engineer, Kansas City, Mo.

THE Turkey Creek sewer is the last step in a large flood protection scheme in Kansas City, Mo., which includes the Kaw River levees and the Turkey Creek tunnel. After many years of agitation the flood protection problem is well on the way toward solution. The engineering features consist mainly of diversion and sewer structures to carry off flood waters originating on the Turkey Creek drainage area, but not until these were constructed could the back water from the Kaw River be kept out of the lower parts of the city.



TURKEY CREEK SEWER DRAINAGE DISTRICT

The political boundary situation was involved almost inextricably because of the winding of the stream across state and municipal boundaries, to say nothing of the necessity of adjudicating and assessing benefits so that adequate funds could be raised. In this article the political boundary situation is outlined briefly, the engineering problem is stated and the design of the Turkey Creek sewer, which is one of the largest capacity structures of its kind yet built, is described.

In 1903 Kansas City was visited by a disastrous flood which inundated a large area on both sides of the state line and caused damage estimated as high as $22,000,000. The damage was caused mainly by the waters of the Kaw or Kansas River, which flows into the Missouri River at the intersection of the Missouri and Kansas state line with the latter stream. As a result of this flood, and another of much smaller magnitude in 1904, the Kaw Valley Drainage Board was created by the Kansas Legislature and a drainage district formed in Wyandotte County, Kan., to pay for widening, dredging and diking the river. This work has been practically completed and the lands which were flooded in 1903 are now believed to be safe from a flood of even greater magnitude, except at the mouth of Turkey Creek, across which the dike could not be constructed until the creek was diverted.

Turkey Creek, which heads in Johnson County, Kan., a few miles south and west of Kansas City, Mo., and drains an area of about 25 miles, enters Missouri near the intersection of 30th St. (produced) and the state line, flows in a northerly direction and crosses the line into Kansas again at a point just south of 19th St. in Kansas City, Mo., and about 100 ft. from the Kaw River, into which it empties. In ordinary times the flow in Turkey Creek is very small except for the sewage which it receives from Rosedale and Kansas City, Mo., for which it serves as an outlet for a number of sewers, the largest of which is the O.K. Creek sewer in Kansas City, Mo., which is a double-box reinforced-concrete sewer each side of which is 16 ft. in height by 15 ft. 8 in. in width at the outlet and which has a capacity of 7,436 cubic feet per second.

Due to encroachment on the channel of Turkey Creek by various property owners and railroads, and the construction of several pile piers in the stream, the channel has been so restricted that it cannot carry off the water in times of excessive rains. This has caused the flooding every few years of a considerable area of business and residence property along the Southwest Boulevard in Kansas City, Mo., near the state line. To relieve this condition a diversion tunnel has recently been completed under Greystone Heights in Kansas City, Kan., and the entire flow of the creek turned through the tunnel, leaving only the portion of the creek north of Mill St., in Rosedale, to be taken care of to make possible the construction of the dike across the mouth of the creek. Previous to June, 1916, at which time the writer was appointed engineer of sewers of Kansas City, Mo., contracts had been entered into with various railroad companies and the Kansas City Stock Yards Co., whereby these companies had contributed to the cost of construction of the Turkey Creek tunnel in proportion to the area of their lands that would be reclaimed by the construction of the Turkey Creek sewer, and Kansas City, Mo., had agreed to complete the construction of the sewer within two years after the completion of the tunnel.

Soon after taking charge of the department the writer began studying the Turkey Creek sewer problem. Considerable time had been devoted to this problem by other engineers and a contract had been entered into with the Kaw Valley Drainage Board providing for the construction of the sewer with an outlet into the Kaw River at the mouth of Turkey Creek. The route of the sewer, as shown on the plan attached to the contract with the Kaw Valley Drainage Board, followed very closely the route of Turkey Creek from 25th St. to the Kaw River and for a considerable portion of the distance between 23d St., and the Kaw River followed the route of the proposed 23d St. viaduct, now under construction. This route was several hundred feet longer than the route finally adopted and the difficulties of construction were much greater on account of the necessity of taking care of the flow of the creek which, north

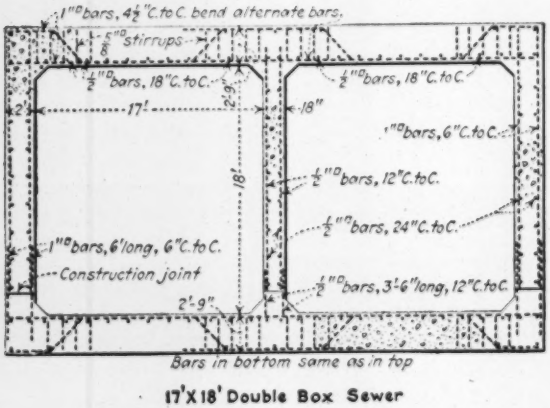
of 25th St., served as an outlet to the Kaw River for the O.K. Creek sewer previously mentioned, and also on account of the sewer being for several hundred feet under the 23d St. viaduct, which it was expected would be completed before the sewer was constructed. Finally, a more favorable contract with the Kaw Valley Drainage Board was obtained which permitted the construction of the sewer on the route shown on the accompanying general plan. A contract had also been entered into with Rosedale, Kan., whereby it had agreed to extend the construction of the proposed sewer west of the state line and remodel a portion of its sewer system to conform to the work to be done by Kansas City, Missouri.

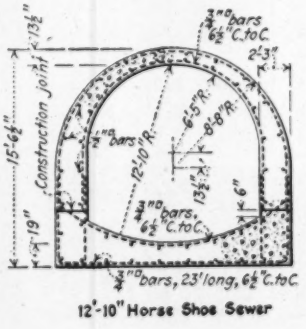
Since the land along the route of the sewer and for a considerable distance on each side is below the elevation of extreme high water in the Kaw River it was necessary to design the main sewer as a pressure sewer and to construct, or reconstruct, the various laterals so that they would act as pressure sewers or go through a pumping station where in times of high water in the river the laterals could be shut off from the main sewer by means of sluice gates and the storm water and sanitary sewage be pumped into the main sewer.

The contract between Rosedale, Kan., and Kansas City, Mo., previously referred to, provided that all lands below El. 40, Kansas City, Mo., datum should be protected from overflow. This necessitated the closing of all openings into the lateral sewers below that elevation or diverting the sewers through several pumping stations.

The elevation of the levee at the mouth of the sewer at the present time is 32 but it is proposed to raise it to 38.5 as soon as the necessary funds are available.

The main sewer, from its outlet to a point just south

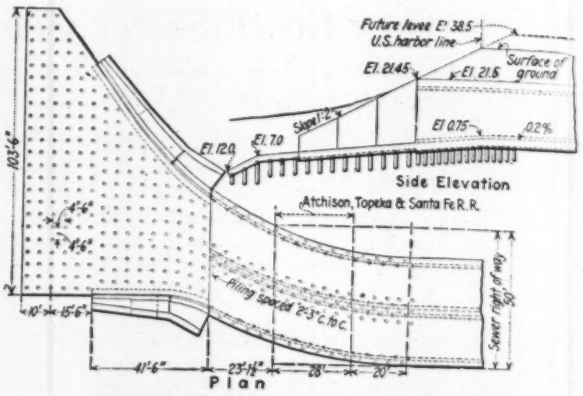

1" ⌀ bars, 4½" C. to C. bend alternate bars.
⅝" ⌀ stirrups
½" ⌀ bars, 18" C. to C.
½" ⌀ bars, 18" C. to C.
2'
17'
2'-9"
18'
18"
1" ⌀ bars, 6" C. to C.
½" ⌀ bars, 12" C. to C.
½" ⌀ bars, 24" C. to C.
1" ⌀ bars, 6' long, 6" C. to C.
Construction joint
2'-9"
½" ⌀ bars, 3'-6" long, 12" C. to C.
Bars in bottom same as in top
17'X18' Double Box Sewer



SECTIONS OF DOUBLE BOX AND HORSE SHOE SEWERS

of 25th St., where the O.K. Creek extension comes in, a distance of 1,860 ft., will be a double reinforced-concrete box each unit of which will be 17 ft. wide and 18 ft. high. From this point south the main sewer will have a horseshoe section, there being 2,340 ft. of 12-ft. 10-in., 1,384 ft. of 11-ft. 4-in. and 1,017 ft. of 7-ft., or a total length of the main sewer of 6,600 ft. There will also be 28,000 ft. of laterals and connections ranging in size from an 8-in. vitrified pipe to a double 15-ft.-8-in. by 16-ft. reinforced-concrete box sewer.

The entire length of the main sewer and a considerable portion of the larger laterals will be under existing railroad tracks or so located that tracks may be constructed over them at any point. For this reason it was thought necessary to provide for a railroad loading

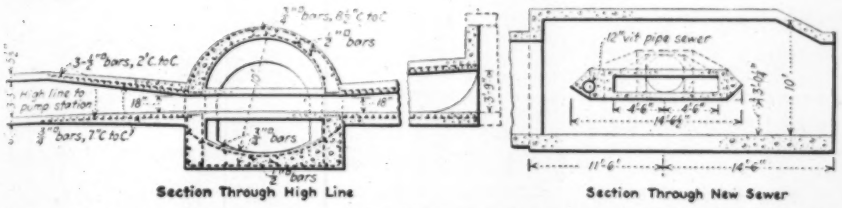


OUTFALL STRUCTURE AT KANSAS RIVER

at all points. The following data were used in making the design:

Design Assumptions for Double-Box Section.—The top and bottom were each assumed to act as a continuous beam of two spans. Earth was taken at 100 lb. per cubic foot and concrete at 150 lb. For live load a Cooper's class E-60 engine was used. The depth of fill over the top of sewer was assumed to be 12 ft. For the live load a transverse distribution at a slope of ¼ to 1 was assumed. The unit live load was obtained by use of the formula $W_L \quad \frac{12{,}000}{8 + \frac{H}{2}}$ H being 12 ft., as stated above. The final unit loadings were as follows: earth 1,200 lb. per square foot; concrete, 450 lb., live load, 860 lb.; total, 2,510 lb. The moment factor used was 1/10; unit fiber stresses, $f_c =$ 650 lb. and $f_s =$ 16,000 lb. Side walls were computed as a simple beam using the above loading and assuming the horizontal pressure to be one-third of the vertical. The moment factor used was ⅛. The center wall was designed as a simple column. The effect of bursting pressure due to a head of water 15 ft. above the top of the sewer was considered for all parts of the structure and steel placed in the outer plane of the side walls to care for this internal pressure. Shear was duly considered and stirrups provided where needed. The box section of the main sewer will have a foundation of clean fine sand and it is believed no foundation piles will be needed except for the outfall structure. Preliminary excavations made to a depth considerably below the proposed bottom of the sewer and just inside of the levee showed that this sand carries no water whatever. Subsequent construction bore out this observation. The horseshoe-shaped section of the main sewer, being for nearly its entire length in the bed of Turkey Creek, and also the extreme east end of the O.K. Creek sewer extension, will require pile foundations.

Openings are provided through the middle wall of the double-box sections to equalize the flow in the two chambers at the time of storms. As the bottom of the



INTERNAL SEWER CROSSING AT ROANOKE ROAD AND SOUTHWEST BOULEVARD

openings are 5½ and 6 ft. above the flow line of the sewer no equalizing of the flow will take place until the sewer is running one-third full. Just below the junction of the 12-ft. horseshoe section with the double 17 x 18-ft. box section there are to be four 6 x 6-ft. openings through the middle wall, spaced 6 ft. apart. The openings at other points will be 5 x 6 ft., in groups of three. Openings 2 ft. wide by 6½ ft. high are also to be constructed in the middle wall opposite the pressure manholes so as to make it possible for anyone who is inspecting the sewer to pass from one chamber to the other.

At several points where lateral sewers cross Turkey Creek the barrel of the sewer will be reinforced to act as a beam and will be supported on concrete piers spaced from 14 to 16 ft. on centers.

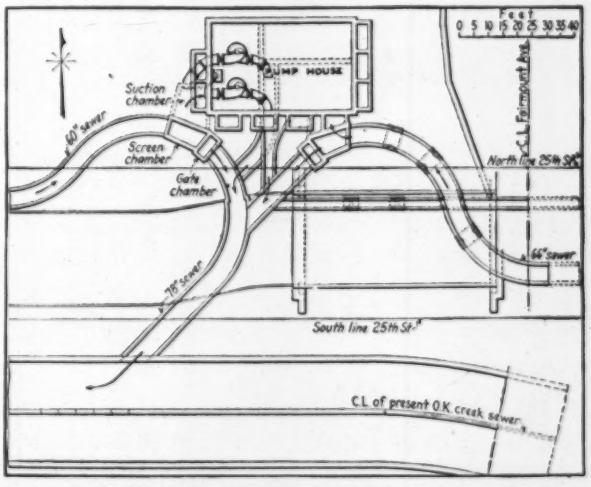
For the run-off factor the writer adopted the one deduced from his investigations in 1912 when designing the O.K. Creek sewer for the Kansas City Terminal Railway Co. (*Engineering Record*, Nov. 2, 1912, page 480.)

The main sewer, O.K. Creek sewer extension and Roanoke sewer were designed for a run-off of 1.5 in., with free discharge on actual grades. With the maximum flood in the river these sewers are good for a run-off of 1 in., using the hydraulic grades. Our investigations failed to reveal any time when the maximum rain has occurred at the time of extreme high water.

The stockyards sewer, which drains a very flat sandy area crossed by many railroad tracks ballasted with crushed rock and cinders, was designed for a run-off of 1 in. All small laterals were designed for a run-off of 2 in., which is the run-off used by Kansas City, Mo., for all short laterals. The total area tributary to the main sewer at the outfall is approximately 5,000 acres.

Pumping Stations.—Two pumping stations are to be installed to pump both sanitary sewage and storm water when the main sewer is under pressure or running so full as to cause backwater in the laterals and flood basements. One station will be located on the northwesterly side of the Southwest Boulevard near 28th St. The other station will be located on the north side of 25th St., immediately west of Turkey Creek. In the Southwest Boulevard station two 30-in. vertical, centrifugal pumps, having a capacity of 30,000 gal. per minute each against a maximum head of 30 ft., will handle storm water; one 10-in. centrifugal pump, having a capacity of 2,500 gal. per minute against a maximum head of 32 ft., will handle sanitary sewage. In the 25th St. station there will be two 30-in. vertical centrifugal pumps, having a capacity of 30,000 gal. per minute each against a head of 30 ft., and two 30-in. horizontal, centrifugal pumps having a capacity of 22,000 gal. per minute each against a head of 15 ft. All these pumps are of the volute, double-suction type, motor driven. Except the sump pumps and the sanitary pump in the Southwest Boulevard station, all units will be used only during times of high water in the Kaw River, into which the main sewer will discharge. This will be for only a short period of time each year and some years possibly not at all. The sanitary pump will be operated during times of high water and also during severe storms which will raise the elevation of the water in the main sewer to a point where it would back up in the sanitary sewers, although the water in the river might be below the pumping stage for the storm water pumps. This unit will be provided with an automatic float control and an electrically operated gong which will notify the watchman of the starting of the pump in order that he may close the gate valve on the sanitary sewer. The sluice gates, of which there will be two at the 25th St. station and one at the Southwest Boulevard station, will be operated through bevel gearing and shafting by 5-hp. motors.

A contract for the construction of the work was awarded in August, 1919, to Thomas Kelly & Sons, Inc.,



TWENTY-FIFTH STREET PUMPING STATION

of Winnipeg, Canada, for $2,453,750. As the work is to be paid for in special tax bills against all the taxable property in the drainage area, and there was some doubt as to the validity of the tax bills on account of a portion of the work being in Kansas, a friendly suit was brought to test the validity of the entire proceedings. A decision was rendered by the Supreme Court of Missouri upholding the validity of the proceedings in the summer of 1920 and construction work was started in October of that year.

Chicago City Drawbridges

Fifty movable highway bridges are maintained by the city of Chicago, the different types being as follows: 24 trunnion bascule bridges, 12 center bearing swing bridges, 12 rolling lift bascule bridges, one vertical lift bridge and one pontoon bridge. Of the trunnion bascule bridges, 22 are of the type developed by the city and the others are of the Strauss and Page & Schnable types. The pontoon bridge is across the Calumet River at Torrence Ave.

Concrete Grandstand Jacked Up to Allow Enlargement

Seating Deck Raised 12 Ft. and Capacity Enlarged—Steel Distorted by Fire Straightened or Replaced

By E. Robinson
Engineer, Terry & Tench Co., Inc., New York City

EARLY in the spring of 1917 there occurred a disastrous fire in the grandstand at the Belmont Park race track, Queens, Long Island, N. Y., which destroyed the entire roof and badly distorted the steel framing. The rear of the seating deck collapsed, together with portions of the mezzanine floor. Work on cleaning up the debris was started immediately after the fire, and a portion of the stand was arranged temporarily so that the spring meeting of 1917 opened according to schedule. Last fall it was decided to increase the seating capacity to 17,500, a feat accomplished in the following manner:

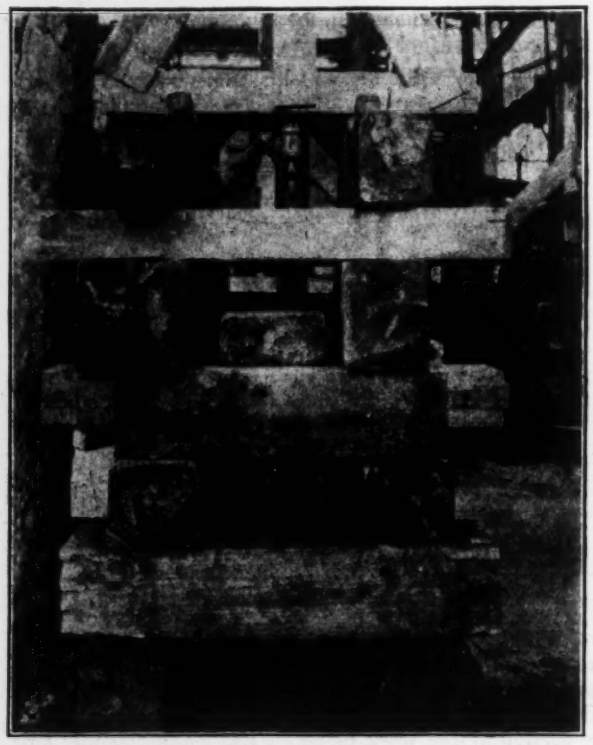


FIG. 1. METHOD OF JACKING AND CRIBBING SHOWING BOTTOM OF INVERTED T-SHORE

The old steel field stand, 125 ft. by 250 ft., which was situated about 250 ft. to the east of the grandstand, was taken down and joined onto the east end of the main grandstand at an angle of 10 deg., with a new connecting bay of 50 ft. inserted between the two stands. First about 25,000 sq.ft. of 3-in. concrete slab in the field stand was removed and all the steel framing marked with assembly marks upon the original erection plan. The original field rivets were burned and cut out and the steel taken down and thoroughly cleaned where rusted and given one good coat of red lead paint. Steel members which were found to be badly pitted were replaced with new material.

To line up the roof it was necessary to erect the old steel stand on concrete piers 6 ft. high and move up on the columns 6 ft. all the connections of the trusses carrying the seating deck. The roof of the old steel stand was carried out in front 21 ft. on a cantilever by adding new trusses and reinforcing others taking added stresses. It was found that the front columns were adequate to take the increased load, so replacement of those members was not necessary.

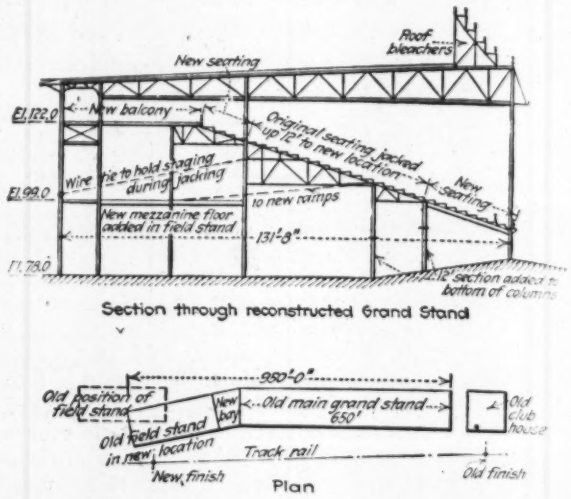


FIG. 2. PLAN AND ELEVATION OF RECONSTRUCTED GRANDSTAND

To add new seating in front of the existing seating area and to improve the line of vision in the combined stand it was found necessary to raise the existing seating area up a distance of 12 ft. above the original level. This was done by jacking and cribbing. The old grandstand was 650 ft. long and the seating area 52 ft. wide, being composed of steel trusses with a 3-in. concrete slab in steps of 1-ft. rise to 3-ft. tread, and weighing about 850 tons. This area was cut into three sections and jacked up to the new level by using fifty-seven ball-bearing screw jacks of a capacity of 15 tons each.

Jacking Operations.—The cribbing was built up around the jack with 10 x 10-in. timbers inverted to make a "T"-shore as shown in an accompanying photograph. The average distance jacked per day was about 12 in. When the staging had been raised a distance of 4 ft., a temporary shore was placed under the load and the cribbing was taken down. Then, after a 4-ft. piece had been spliced to the shore, the jacking operations were resumed until the next 4-ft. level was reached. Then again cribbing was taken down, the shore spliced, and the jack started from the base level. This method of changing shores was economical of cribbing and maintained the jack close to the ground. At each point where the shoring was spliced a longitudinal brace was placed consisting of two planks, each 2 x 10 in. in a "T" form and tied to the column with a sliding yoke brace. The columns were spaced 16 ft. 8 in. in a longitudinal direction.

Jacking of this large area of concrete surface 3 in. thick was accomplished without any damage to the concrete from cracking or from other causes, and progressed without any interruption or delay. Extreme care was taken that all parts jacked were kept in a level plane. Very little effort was necessary to operate the jacks.

When the jacking was first started the staging was

allowed to sag away from the columns about 1 in., being tied back securely to the rear of the stand with ½-in. wire cable and turnbuckles. This was done in order to clear the rivet heads of the columns, the cables being carefully watched and properly adjusted at all times. In addition to the back ties, the section being jacked was anchored at each end and crossbraced with ½-in. wire cable with turnbuckles. Each night before quitting time the load was released from all jacks by wooden wedges being driven hard up on top of the cribbing.

FIG. 3. ONE OF THE TWISTED STEEL COLUMNS WHICH WAS REPLACED

All through the stand were found steel members which were badly twisted and bent from the fire of 1917. All the old steelwork was carefully inspected. Top chords of trusses were buckled in places as much as 6 to 8 in. in sharp kinks, and columns which stood up and carried loads were found to have sharp buckles where the plates and angles bent together 5 in. out of line in a 2-ft. length of column. A large number of trusses were taken out and replaced, and where only top or bottom chords were damaged the load was taken off the truss was cut off the west end, moved along the roof and joined onto the east end of the bleachers, this bringing it on top of the new bay and a portion of the reconstructed steel span. The moving of these bleachers and the arranging of the east end of the grandstand into boxes and inclosures for members of the club were required by the reversing of the direction of running the races, so that now the inside of the track is to the left of the horses.

The work was under the personal direction of Maj. August Belmont, president, and Joseph E. Widener, of the Westchester Racing Association, and Charles W. Leavitt, architect. The American Bridge Co. fabricated the steel. The general contractors on the work were the Terry & Tench Co., Inc.

Pure Iron in Early American Bridge

By D. M. Strickland
Research Dept., American Rolling Mill Co., Middletown, Ohio

In 1835 a wrought-iron arch bridge was erected between Brownsville and Bridgeport, Pa., near Pittsburgh, which has remained in service to the present day. It is in excellent condition from a corrosion-resistance standpoint. A local history published in 1903 by a Mr. Hart not only gives its date of construction as cited but also states that it is the first structural iron bridge built in America. The bridge is of special interest for this reason. The fact that the iron has withstood the corrosive elements for more than 85 years has attracted much attention and led to a chemical investigation of it.

Recently the author had the opportunity to analyze a sample taken from this structure and found the old iron

FIG. 4. SEATING AREA JACKED AT FULL HEIGHT—PART OF STEEL FOR ADDITIONAL SEATING AREA IN PLACE

and new material used. All punching was done on the job from plain material cut to fit. Columns which were badly kinked were cut out at the underside of the roof connection and just above the mezzanine floor, and new sections of a length of 20 ft. were spliced in.

In providing for the increased seating capacity ten new ramps were constructed. These ramps were 16 ft. wide and about 50 ft. long running from the center of the seating area to the rear. On the roof there was originally located a steel and concrete frame bleacher stand 600 ft. long. A length of this span 200 ft. long

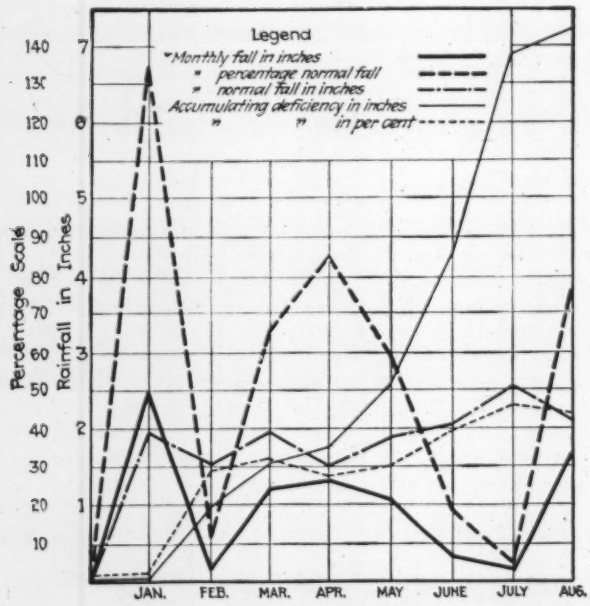
to be nearly as pure as the rust-resisting, commercially pure iron manufactured in openhearth furnaces at the present day. The analysis showed Si 0.05 per cent, S 0.025, P 0.200, C 0.037, Mn 0.003, Cu trace, N 0.006 per cent. This is a truly remarkable purity, considering the older inadequate manufacturing methods and lack of metallurgical and chemical control.

The iron of this historic bridge was manufactured in the town itself. It was made in the plant of John Snowden, an immigrant from England. His first forge and mill were built in 1824.

The Drought in the British Isles

(London Correspondence)

FROM the beginning of February to the end of September there were over 170 rainless days in England, and the country had received less than 60 per cent of its normal rainfall. In London only 8.32 in. of rain fell between Jan. 1 and Aug. 31, which is only 56 per cent of the average rainfall. The monthly falls in London, with their percentages of the normal, are shown by the chart. Indeed, so severe has been



RAINFALL AT LONDON, ENGLAND, IN 1921

the drought that England has this year bordered on the conditions found in semi-arid lands where the normal annual rainfall is between 10 and 20 in. These conditions have, however, not been uniform throughout the British Isles. In Scotland, the rainfall has kept around the normal, and, at the end of September, Scotland had an excess of 1.5 in. Ireland finished up in September 4.5 in. short, while England was nearly 9 in. below the normal fall.

Should England receive its normal fall during October, November and December, the economy measures put into operation in London and the other large cities will still be necessary.

In London, where the water supply is derived from the Thames, its tributary the Lea and a number of deep chalk wells, the Thames Conservancy and the Metropolitan Water Board have been hard put to it to ensure adequate supplies from the Thames and its reaches without involving any hazard to navigation. The Metropolitan Water Board has economized to the extent of 20 m. Imp. g.d., but appeals to the public are still being made and prosecutions and fines follow water waste, such as watering gardens or washing down automobiles with hose.

Construction has been begun on a new reservoir for London to hold 7,500,000,000 Imp. gal., but owing to the war and to government control this project had to be postponed. It was due for completion last year and will now be ready by 1923. London will be short of water until the Thames is replenished, since this river is its chief source of supply and long and heavy falls are necessary before the river returns to normal condition.

The other large cities have suffered to a greater or less extent. Those cities in northern England, such as Manchester and Newcastle, have been short but not to the same extent as the south of England where the drought has been most serious. Manchester, for instance, which has the reputation of being the wettest town in England, derives its supply from Thirlmere in the English Lake district. The dam here conserves 8,000,000,000 Imp. gal. of water for conveyance to Manchester about 90 miles away.

The Liverpool supply is obtained from Lake Uyrnwy in Wales, 68 miles away, and here the shortage has been badly felt, for Cardiff up to Aug. 31 had only 15.41 in. of rain, which is 57 per cent of the normal.

The Midlands are supplied from valleys in the Peak District of Derbyshire, except Birmingham, which obtains its water from the Elan valley in south Wales. Several cities have been very badly hit by the drought. In Bath, for instance, the springs are only giving 742 Imp. gal. a minute, against a normal of 1,300 gal. Here the water supply is cut off for 16 hours out of the 24 so as to conserve the springs as far as possible. The Revesby reservoir which supplies Boston is dry, and 22,000 Imp. gal. of drinking water are daily distributed in the streets at a cost of £200 per week. Many other cities, Brighton for instance, have their supplies cut off for 12 hours every day.

Survey of Underground Supplies

A geological survey has just been made of the underground water supplies of the counties of Buckinghamshire and Hertfordshire which afford much of the well water for London. In these counties the supplies derived from superficial gravels, and sandy beds of the lower tertiaries, are really insignificant, the main source being the chalk which has only one rival in Britain, that being the new red sandstone in the Midlands. The chalk formation here, while it may be regarded as homogeneous, from the point of view of water supply, possesses local differences which give rise to a certain amount of distinction between waters of the upper, middle and lower chalks. The results of this survey have shown that the water is derived from the joints and bedding planes rather than from the chalk mass, and that boring saturated chalk is of little use for pumping where there is an absence of fissures. A new survey is investigating this point and should be of great assistance to engineers in estimating the proportion of rainfall which can be expected to accumulate in any specific catchment area.

Such an unusual occurrence in Britain as a drought has prompted the Ministry of Health to collect particulars of the supplies of potable water in England and Wales, and to call attention to the advisability of taking advantage of the drought to ascertain the minimum available resources under exceptional weather conditions.

The drought has served to stimulate interest in water supply, in which branch development is badly behindhand. Had reliable data been available before the present drought it would have saved considerable sums of money which have been spent on elaborate supply schemes which have not been justified by results.

Combating Electrolysis in Water Pipe Systems

IN A paper entitled "Discussion of the Causes and Prevention of Electrolysis Troubles in Underground Pipe Structures" presented at the recent convention of the California Section, American Water Works Association, E. B. Stewart reviewed experiences of the East Bay Water Co., of Oakland, Cal., for which company he is electrical engineer. The paper touches upon three methods ordinarily used in combating electrolysis namely, surface insulation, drainage systems and insulation joints. The first of these was not considered important. Extracts from the paper dealing with the other two methods follow:

A drainage system for conducting electricity away from pipes by connecting them to rails or negative buses can be used to advantage under certain conditions as a secondary means of lessening electrolysis, but the installation of such a system as a principal means of electrolysis mitigation in a large city is unwise. In suburban areas where the pipe networks are small, a limited drainage system may offer the best means of dealing with the electrolysis problem, provided there is no appreciable leakage of current from the rails at points remote from the power station.

If the drainage system is used where the pipe network is steadily increasing the load continually increases, more and heavier bonds become necessary, and the current in the pipe finally becomes so great that any further extension of drainage would be a menace to the system. The placing of additional bonds between pipes transfers the trouble from where it has been most evident to a new location where it may require some time to manifest itself anew. Hence the intervening lull creates a favorable impression and has made the drainage system popular.

Danger of Bonding to Rails

Bonding to the rails at points remote from the power station should not be permitted. The disadvantage of such connections is illustrated by the following citation of experience in Oakland. At a point 2,900 ft. from the power house, indicating meter tests showed the pipe to be of positive potential to the rail and at the point where the pipe line crossed beneath the rails a connection was put in to lower this potential. In making the meter tests no account was taken of the potential of the rails with respect to the earth or to the likelihood of reversal of current flow from rails to the pipe during certain changes in the load distribution. The result was that while the bond between pipe and rail removed the discharge of current from the pipe to the rails, the pipe was still positive to the earth and a heavy discharge of current over the bond and into the earth took place, causing rapid deterioriation of the pipe near the point where the connection was made.

The safest and most economical plan for cases of this sort would be to enclose the pipe in a wooden conduit packed with insulating compound. This method is expensive, but serves the dual purpose of insulation at the point and reducing the amount of current that will accumulate on the pipe in outlying areas.

Pipes are often damaged on streets where there are no car tracks. In one case, where a number of services were found to be leaking, investigation showed that a cable conduit passed directly beneath them. The services were one-tenth of a volt positive to the cables. In this case the soil was wet clay and the nearness of the pipe to the conduit made up for the comparatively low potential. This illustrates the necessity for conducting tests between pipes and underground cable systems. In laying service pipes, cable conduits should be avoided even more than street car tracks. This is much more important in wet clay than in sandy soil.

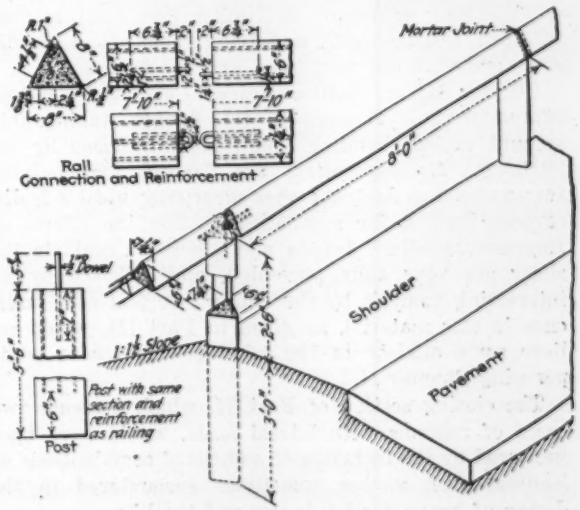
The most valuable means of mitigating electrolysis troubles lies in the proper use of insulating joints and the extensive use of such joints should be encouraged in new work and in making repairs. The objection to their use and the danger to be guarded against is a combination of conditions that will permit the current to shunt around the joint and cause destruction of the pipe on the positive side of the shunt. The kind of joints best suited to certain conditions, their spacing and complications arising from the nearness of other pipe systems not so insulated are all important factors that must be taken into consideration to secure adequate protection.

As a general rule, when a pipe line is laid with an insulating joint at every fourth or fifth length of pipe, the line has such a high electrical resistance that no measurable current will flow in it, even though considerable current is flowing parallel in the earth nearby. On wrought iron and steel pipes it has been found necessary to increase the efficiency of the joint by surrounding both joint and pipe with a wood box packed with insulating compound. The advisable length of such boxes will depend upon the resistance and amount of current in the earth. Although the box does not materially increase resistance, it gives a more even distribution of leakage current and is therefore a considerable advantage when the resistance of the surrounding soil is very low.

For the Oakland system the flanged type of insulating joints has been found the most desirable and economical for use on wrought iron and steel pipes. This joint is made up of a disc of red or gray fiber between the surfaces of the flanges, and washers of the same material under heads and nuts of the bolts. For pipe with bell-and-spigot joints a short wooden ring is used between the inside of the bell and the end of the spigot to prevent metallic contact and the joint is then calked with cement.

Inexpensive Concrete Guard Rail

A REINFORCED concrete guard rail, which simplifies the problem of precasting and is easy to erect, is being employed this season by L. D. Brownell, division engineer, where wood guard rail has to be replaced in the Fourth Division, New York States Highways. The



REINFORCED-CONCRETE GUARD RAIL, N. Y. STATE HIGHWAYS

post and rail are of the same section, as is indicated by the illustration, so that a single V-trough mold serves for both. In casting the rail, the stirrups, which hook over the dowel pin in the post, are given sufficient length to take up slight variations in spacing the posts. A mortar joint, carefully pointed, protects the metal parts of the connection and gives the rail a neat paneled appearance. As installed this year the railing has cost about a dollar a lineal foot.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Comprehensive Treatise on Columns

REVIEWED BY FRANCIS P. WHITMER
Consulting Engineer, New York City

COLUMNS: A Treatise on the Strength and Design of Compression Members—By E. H. Salmon, D. Sc. (Engineering) London, Assoc. M. Inst. C. E. From a Thesis Approved for the Degree of Doctor of Science (Engineering), in the University of London. London: Henry Frowde and Hodder & Stoughton. Cloth; 6 x 9 in.; pp. 279; illustrated. 31/6 net; postage 1s. extra.

This remarkably comprehensive treatise, comprehensive in the historical, theoretical and experimental aspects, is divided into three parts: a 16-page bibliography, and sections devoted to the "analytical" and "synthetical" aspects of the subject.

The bibliography covers nearly 400 references, arranged chronologically, to work of European and American investigators over a period from 1729 to 1920. It is so complete that the omission of Prof. S. W. Robinson's paper, "Strength of Wrought-Iron Bridge Members," (Van Nostrand Science Series, 1882) attracts notice. This valuable little work develops a general method for the solution of problems in combined bending and direct stress, solving a number of special cases, only two of which are presented by Dr. Salmon.

Chapter I of Part II, "Analytical," develops a series of general expressions for a flexed column, which are applied first to a round-ended "ideal column" and then in turn to round-ended columns with initial curvature, initial eccentricity and variable modulus of elasticity, finally combining all three conditions in what is termed an "ordinary column." A similar treatment is then accorded columns with end-fixing moments, with flat ends, and with one round end and one fixed end.

Chapter II, on "Lattice-Braced Columns," develops expressions for stresses in the flanges, taking into account various bending conditions introduced by the latticing. No expressions are derived for shearing forces which, at first, is rather surprising, until it is discovered that in the synthetical section the efforts of Engesser, Keelhof, Jansen and others to evaluate the shear are very fully presented, and followed by an interesting analysis by the author. A foot-note reference to this material, as given in Part III, would relieve some anxiety in the mind of the reader while perusing Chapter II.

The closing section of Part II, which presents two cases of columns with lateral loads, would have been improved by the inclusion of additional combinations of loading, such as are sometimes encountered in the design of heavy derrick booms and the like.

As a general comment, it may be said that the analytical work would have lost none of its practical value and its somewhat forbidding aspect would have been relieved if the analyses had generally terminated with the derivation of the maximum column deflection, instead of being developed into expressions for resultant fiber stress. Moreover, the practical value of many of the simplified expressions for fiber stress is lost by reason of the author's assumption of a minimum factor of safety of 4 as compared with the ultimate load given by Euler's formula. This factor is much higher than that corresponding to any of the formulas used in current American practice.

Part III, "Synthetical," comprises an exhaustive compilation of the theoretical and experimental work of the last two centuries, logically presented and ably discussed. Practically every known type of column formula and every reported column test receives attention. The many difficulties in the way of a practical formula with a purely theoretical basis are emphasized, and the conclusion is reached that some type of empiric formula in agreement with experiment is the best to adopt, preference being finally expressed for the Johnson parabola tangent to Euler's curve. Among matters demanding attention in future research is mentioned "the degree of imperfection common in practical direction-fixed ends," involving the problem of secondary stresses as affecting the deflection curve of columns in a framed structure, undoubtedly a vital obstacle to a satisfactory theoretical consideration of columns as encountered in practice.

The notation and the analytical methods employed in the book are very logical and clear. The typography and the figures are satisfying and quite free from important errors. On the whole, the book is perhaps the most complete work upon the subject of columns in all its aspects that has yet appeared, and seems to leave but little unsaid.

Light on the Problem of Social Justice

THE UNSOLVED RIDDLE OF SOCIAL JUSTICE—By Stephen Leacock, B. A., Ph. D., Litt. D., F.R.S.C., Professor of Political Economy at McGill University, Montreal. New York and London: John Lane Company, Toronto: S. B. Gundy. Cloth; 5 x 7 in.; pp. 152; $1.25.

Unsolved though Prof. Leacock leaves the riddle of social justice at the close of his brilliant analysis, he does not fail to throw much bright light on its complexities and on the involved reactions that follow from any and all attempts at a solution that have ever yet been tried. Better yet, he offers concrete suggestions of wide appeal.

Skillfully the author shows the fallacies of the *laissez faire* and associated doctrines on the one hand and of socialism on the other. Either way lies disaster. High praise is given to Bellamy's "Looking Backward" as one of the best conceptions of the ideal socialistic state but it, like all other Utopias, will not stand the human work-a-day test. Progress lies along the line of still further social control, with opportunity opened to every child, employment aids for adults, an extension of the minimum wage and of shorter hours movements, and wise control of land speculation and other sorts of profiteering. Just how these principles and practices are to be extended the author cannot reasonably be expected to say in so short an essay and in view of all the uncertainties. In the main, progress must come through experience.

Those who do not know of Prof. Leacock's grasp of political economy and his literary ability can learn much of both to their profit from an hour or two spent in reading this stimulating volume.

The F. A. E. Survey of Waste in Industry

WASTE IN INDUSTRY—By the Committee on Elimination of Waste in Industry of the Federated American Engineering Societies, Washington, D. C. New York: McGraw-Hill Book Co. Cloth; 6x 9 in.; pp. 409. $4.

To make in a short time a survey that might afford a stimulus to industrial and commercial leaders, labor organizations and government officials, to attack anew and vigorously the elimination of industrial wastes, was the first large proposal made to the American Engineering Council by Herbert Hoover when he become its chairman. The task was brought to a conclusion in five months, and the complete report appears under the title, "Waste in Industry."

In the original plan the survey of ten industries was contemplated. This number had to be reduced to six: Building construction, men's ready-made clothing, boot and shoe, printing, metal trades and textile. Studies in transportation and bituminous coal mining were made but were not completed in time to be included in the report; the same is true of a regional survey of the industries of the city of Worcester.

The material gathered is presented in three parts: (1) A summary of the detailed reports; (2) six chapters, each of which consists of the engineer's report on one industry; (3) seven chapters of general reports, dealing with unemployment, strikes and lockouts, legal machinery for adjusting disputes, industrial accidents, health of industrial workers, eye conservation, and purchasing and sales policies.

It was the expectation when the survey was undertaken that its results could be expressed in a relatively few figures which would indicate the magnitude of our industrial wastes, or at least those of the particular industries surveyed. In fact, the plan was based on the assumption that by taking representative plants the results could be multiplied by factors representing the proportion which the whole industry bore to the plants surveyed and totals thus arrived at with some show of justification. He who approaches the completed report in the expectation of finding these quantitative indexes will be disappointed. No such composite figures are presented.

This does not mean, however, that the report is without value. In fact, it has very decided value and should stimulate efforts in wide circles to reduce industrial waste. And this is true not only as applied to those engaged in the industries assayed but to all who have contact with industry of any kind.

The value lies in the presentation of a method of industrial assay that can be rather easily applied to any industry; in the qualitative conclusions, i.e., in the definite classification of wastes and indication of the corresponding methods of elimination; in the quantitative results in certain industries, which results in general terms are transferable to other industries; and finally, in the stimulating character of both the specific industry and the general reports.

The method of assay consisted in obtaining by personal investigation by competent specialists the answers to 260 leading questions, falling into 58 main topics, which in turn were classified under three main heads—wastes in organization, including the human factor; wastes through deficiencies in technical knowledge, which was taken to embrace the physical factors (plant, equipment, design, etc.); wastes in plant utilization, which was interpreted as covering operations. As to each question subject, also, it was determined what per cent of the waste was due to management, to labor and to outside contracts. Scales were set for the guidance of the inquirers, so that the procedure in all the studies was uniform. The method, while necessarily requiring knowledge and judgment in application, is relatively simple and would help any experienced executive to form a fairly reliable estimate of the extent of his wastes.

The character of the wastes disclosed are classified and discussed under four heads: (1) Low production caused by faulty management of materials, plant, equipment and men. (2) Interrupted production, caused by idle men, idle materials, idle plants and idle equipment. (3) Restricted production, intentionally caused by owners, management and labor. (4) Lost production caused by ill health, physical defects and industrial accidents. Under each of these heads there are quantitative citations of losses in given industries, the whole conveying a definite impression—even though composite loss figures are not arrived at—of very great waste in our industrial functioning. The industrial manager or worker must be hardened indeed who does not feel quickened by this picture of wastes and the consequent opportunity for savings to individuals and companies and to the whole community.

From the reports on specific industries the same sort of stimulus is derived. The major causes of wastes, are, in most of the reports, clearly disclosed and the corresponding remedies pointed out. Of particular interest to readers of *Engineering News-Record* will be Sanford E. Thompson's report on the building industry, a careful and illuminating inquiry into building wastes. (For abstract thereof see *Engineering News-Record*, July 28, 1921, p. 169.) Mr. Thompson also made the study of the shoe industry, which presents an equally interesting, but naturally materially different situation.

Of the general reports those on unemployment and on health of industrial workers make a strong appeal and will prove well worth the careful reading of those who are concerned with industrial functioning and desire to see its wastes cut down.

All in all, despite the failure to produce composite figures indicative of the magnitude of industrial wastes, either in industry as a whole or in particular branches, American Engineering Council has rendered through this study a valuable public service. The report holds much helpful information as to classes and causes of waste and method of study and elimination.

Public Health Work in England

THE STORY OF ENGLISH PUBLIC HEALTH—By Sir Malcolm Morris, K. C. V. O.; President of the Institute of Hygiene; Fellow of the Royal Sanitary Institute. (English Public Health Series). New York: Funk & Wagnalls Co. Cloth; 5 x 8 in. pp. 166. $1.50.

Although going back to examples of the "scientific instinct" and of the "new humanity" in much earlier years the author confines himself chiefly to events of the last seventy-five years in this readable and inspiring sketch of the public health movement in Great Britain. The first and short-lived board of health was created in 1848, as a result of somewhat earlier investigations made by Edwin Chadwick and others. The work of this board and its successors, including particularly the Local Government Board and, of very recent origin, the Ministry of Health, is outlined, as are the activities of a number of leaders in public health work. The activities of local health authorities are also sketched. Stress is put upon the part played by sanitarians.

The Thermal Properties of Concrete

STUDIES ON COOLING OF FRESH CONCRETE IN FREEZING WEATHER—By Tokujiro Yoshida. Urbana, Ill.: University of Illinois, Engineering Experiment Station. London: Chapman & Hall, Ltd. Paper; 6 x 9 in.; pp. 63; illustrated. 30c.

THE THERMAL CONDUCTIVITY AND DIFFUSIVITY OF CONCRETE—By A. P. Carman and R. A. Nelson. Urbana, Ill.: University of Illinois, Engineering Experiment Station. London: Chapman & Hall, Ltd. Paper; 6 x 9 in.; pp. 39; illustrated. 20c.

The two bulletins noted here are unrelated except that they represent somewhat allied experiments made in the same institution.

Prof. Yoshida's "Studies on Cooling of Fresh Concrete in Freezing Weather" is an elaborate investigation of the thermal properties of setting concrete, which includes the establishment of thermal constants, diffusivity, and the ratio of emissivity to the coefficient of thermal conductivity. These sound as though they required a highly scientific intelligence for their understanding. That is a fact. The bulletin is of much more value to the laboratory man and the physicist than it is to the expert concrete worker, although the latter is evidently in the mind of the author. What the author does is to establish the thermal constants of a setting concrete under varying conditions of deposition, mixture, protection, etc., and with them as a basis work out a number of curves by means of which, aided by some elaborate equations, one can ascertain the temperature of a concrete. Knowing the temperature which is required for removal of forms, that is, the strength which concrete will reach under certain temperatures, one can then proceed more intelligently to the removal of forms. Unfortunately, the data are so elaborately stated that there is great doubt if they will ever be used, in their present form at least, by the actual concrete placer.

The Carman and Nelson investigation is frankly for the physicist, although the values which they determine are required in certain kinds of engineering studies. Their experiments establish certain values for thermal conductivity and thermal diffusivity, which constants have not hitherto been available.

Equipment for Handling Materials

MATERIAL HANDLING CYCLOPEDIA—A Reference Book Covering Definitions, Descriptions, Illustrations and Methods of Use of Material Handling Machines Employed in Industry—Compiled and Edited by Roy V. Wright, Editor-in-Chief, Managing Editor, Railway Age, and Editor of the Railway Mechanical Engineer, Car Builders' Dictionary and Cyclopedia, and Locomotive Dictionary and Cyclopedia; John G. Little, Managing Editor, Railway Age and Robert C. Augur, Associate Editor. New York: Simmons-Boardman Publishing Co. Cloth; 8 x 12 in.; pp. 846; illustrated. Cloth, $10; leather, $15.

This volume is a super-catalog of materials handling equipment, with an extended glossary or list of definitions. It serves its purpose excellently in text and illustration. There are few devices that are not described or illustrated, and, with the glossary for detail, the user of handling machinery can locate such information he is likely to want. There is no critical discussion.

Part I, of about 140 pp., is composed of definitions presented after the manner of the various "Dictionaries" familiar to engineers and to railway men in particular. Part II is the body of the book, some 540 pp., and describes and illustrates in order hoisting machinery, package-handling conveyors and elevators, loose materials, conveyors and elevators, conveying machinery details, elevators, trackless transportation, industrial rail transportation and handling systems. With a final selected catalog section of about 100 pp., the purpose of the book as a gazetteer of handling equipment is well carried out.

Concrete Ties

CONCRETE RAILWAY SLEEPERS: Notes compiled by the Technical Section, Indian Railway Board, with an Introductory Note by F. G. Royal-Dawson, M. Inst. C. E., late Chief Engineer with the Railway Board. Calcutta: Superintendent of Government Printing. Paper; 8 x 13 in.; pp. 88; folding plates and other illustrations. Rupees 3, annas 4.

Single-piece ties and ties composed of pairs of rectangular blocks and circular bowls are represented in this publication in a miscellaneous collection of designs tried in numerous countries. Most of the experiments noted have been on a small scale. Much of the information is old, and collected from other publications. Further, it deals more with description than with records of service. Nevertheless, the monograph is of value in bringing together a mass of information for reference and study. One of the interesting features relates to designs for Indian railways. Owing to the extensive use of pots and bowls of cast iron and steel for ties in India it is natural to find similar designs in concrete. Actual experience, however, has been limited. Large drawings are given of some of these designs. No summaries or conclusions are presented, but it is evident that a concrete tie satisfactory for main track service has yet to be developed.

More New England Rainfall Statistics

In the September Journal of the New England Water Works Association (Tremont Temple, Boston, Mass.; 75c.), X. H. Goodnough, chief engineer, Massachusetts Department of Health, presents New England rainfall statistics for the years 1913 to 1920, supplementary to those given in his paper in the Journal for September, 1915, which came down to the close of 1912. Many new stations have been added since 1912 and some overlooked long-time records have also been included. Data for adjacent parts of Canada and New York are given. Monthly and yearly totals are given by years and averages by months and by years. Elevations of stations are given.

A Pictorial Industrial Magazine

Industry Illustrated, an 11 x 14-in. monthly magazine, has been launched (10c. a number or $1 a year; Engineering Magazine Co., New York City). The editor is John H. Van Deventer, formerly of the *American Machinist*. The reading pages consist almost wholly of halftones, with some text in large type. Among the articles in the first issue are "Inventors Who Have Made It Pay" and "The Passing of the Roustabout; The Mechanics of Moving Materials."

Power Map of New York Available

The United States Geological Survey has issued a large-scale map of the State of New York showing upon it all of the hydro-electric and steam-electric power stations, and the main transmission lines in the state (Washington, D. C.; 50c.). It is a clear and explicit map, and should be useful to many.

Fire Protection in Electrical Stations

Thirty-five pages of the October Quarterly of the National Fire Protection Association (87 Milk St., Boston, Mass.) are devoted to an article on Fire Prevention in Electric Power Stations from the Operator's Point of View, by F. A. Allner, general superintendent, Pennsylvania Water & Power Co.

PUBLICATIONS RECEIVED

ACCIDENT BULLETIN NO. 78 AND 79: Collisions, Derailments, and Other Accidents Resulting in Injury to Persons, Equipment, or Roadbed, Arising from the Operation of Steam Roads Used in Interstate Commerce. (1) October-December, 1920, and Year 1920. (2) January-March, 1921. Bureau of Statistics, Washington, D. C. Paper; 9 x 11 in.; pp. 94 and 190. 5c. per copy or 15c. per year from Superintendent of Documents.

AMERICAN SOCIETY OF CIVIL ENGINEERS: Index to Transactions, Volumes I to LXXXIII (1867 to 1920). Prepared Under the Direction of the Committee on Publications by Elbert M. Chandler, Acting Secretary. New York: The Society. Paper; 6 x 9 in.; pp. 272.
Papers are entered under (1) topics and (2) authors, in each case alphabetically by titles. Well done and useful.

THE AUTOMOBILE INDUSTRY AND ITS FUTURE—By Leonard P. Ayres, Vice-President, the Cleveland Trust Company. Cleveland, Ohio: The Company. Paper; 6 x 9 in.; pp. 32.
An interesting, painstaking analytical study of wide appeal.

BUILDING OFFICIALS CONFERENCE: Proceedings of the Seventh Annual Meeting, April 27-30, 1921. Springfield, Mass.: Fred W. Loomis, Building Commissioner, Secretary. Paper 6 x 9 in.: pp. 75.

DANIEL H. BURNHAM, ARCHITECT, PLANNER OF CITIES—By Charles Moore. In two volumes. Boston and New York: Houghton Mifflin Company. Cloth; 8 x 11 in.; pp. Vol. 1, 260; Vol. 2, 238; Illustrated. $20.

CONTRIBUCION AL ESTUDIO DE LOS RECURSOS HIDRAULICOS PARA FUERZA MOTRIZ EN EL PERU—Por El Ingeniero Juan N. Portocarrero C. Contribucion Presentada a la Seccion VI Del Congreso Nacional de la Industria Minera. Lima, Peru: Imp. Torres Aguirre. Paper; 7 x 9 in.; pp. 64.

THE EDUCATION OF HEALTH OFFICERS — By George C. Whipple, Professor of Sanitary Engineering, Harvard University, Cambridge, Mass. Reprinted from the International Journal of Public Health, Vol. II, Nos. 3 and 4, 1921. The Author. Paper; 7x10 in.; pp. 35.

ELEMENTARY CONCRETE CONSTRUCTION—By Leon H. Baxter, Supervisor of Manual Training, St. Johnsbury, Vt. Milwaukee, Wis.: The Bruce Publishing Company. Cloth; 6 x 9 in.; pp. 101; illustrated. $1.25.
A book of instruction for the manual training student; how to make concrete products and to place concrete, illustrated by photographs of school boys at work.

FOREST EXPERIMENT STATIONS—By Earle H. Clapp, Assistant Forester, Forest Service, Circular 183, Oct. 1921. Washington, D. C.: U. S. Department of Agriculture. Paper; 6 x 9 in.; pp. 34. 10c. from Superintendent of Documents.

INDUSTRIAL WASTES FROM THE STOCKYARDS AND PACKINGTOWN IN CHICAGO: Report to the Sanitary District of Chicago, January, 1921. Albert W. Dilling, Chief Engineer; Langdon Pearse, Sanitary Engineer. Chicago: The District. Cloth; 6x9 in.; pp. 261.
An abstract of this report on activated-sludge, Imhoff tank, sprinkling filter, screening, and grease recovery tests was printed in *Engineering News-Record*, May 12, 1921, p. 815. Altogether, the tests covered nine years. A preliminary report was published in 1914.

MACHINE DRAWING: A Text and Problem Book for Technical Students and Draftsmen—By Carl L. Svensen, M.E., Assistant Professor of Engineering Drawing in the Ohio State University, Member American Society of Mechanical Engineers, Society for the Promotion of Engineering Education, etc. New York: D. Van Nostrand Company. Cloth; 6 x 9 in.; pp. 214; illustrated. $2.25.

MODERN ROAD BUILDING: Address by R. E. Fishburn, Chairman Pima County, Arizona, Highway Commission, before American Association of Engineers, Tucson, Arizona. Paper; 6 x 8 in.

PRACTICAL BUSINESS METHODS FOR ENGINEERS AND CONTRACTORS AND ARCHITECTS—By Frank R. Walker, Assoc. Am. Soc. C. E. Chicago: 2209 Archer Ave., Frank R. Walker Co.; 8x11 in.; pp. 80.
Forms and methods of construction accounting for contractors, engineers and architects.

PRICE CHANGES AND BUSINESS PROSPECTS—By Leonard P. Ayres, Vice-President, Cleveland Trust Company, Cleveland, Ohio. Paper; 6 x 9 in.; pp. 27. Illustrated.
An unusually clear and readable study in brief compass. Gives (with 1914 as basis) changes in cost of living and also in wholesale and retail prices, 1915 to 1921, for the United States; wholesale prices for the same period in the United States, England, France and Italy; wholesale prices in the United States for 110 years and weekly wages for 100 years, for artisans and common labor; prices for 25 selected industrial stocks for 22 years; and a brief summary and forecast. One of the conclusions is that we are probably "entering upon an extended period of falling prices, broken by occasional shorter periods of rising prices." Urges accumulation of data that will show business cycles, and keen watchfulness to note our position in the cycle at every moment.

PRODUCTION OF EXPLOSIVES IN THE UNITED STATES: Year 1920, with Notes on Mine Accidents Due to Explosives. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 44.

QUEBEC STREAMS COMMISSION: Ninth Report, 1920. Quebec, Canada: Louis R. Proulx. Paper; 7 x 10 in.; pp. 139.

REPORT OF THE PUBLIC SERVICE COMMISSION OF THE STATE OF NEW YORK: Year ending Dec. 31, 1917. Vol. III. Statistics of Light, Heat and Power Companies. New York. Bureau of Statistics and Accounts. Cloth; 6 x 9 in.; pp. 605.
Another example of long delay in publishing governmental reports, but apparently not chargeable to the commission.

THE ROCKEFELLER FOUNDATION: A Review for 1920; The Program for 1921—By George E. Vincent, President. New York: The Foundation. Paper; 6 x 9 in.; pp. 47; illustrated.

SALIENT FEATURES OF ELECTRIC COOKING, ELECTRIC HOT WATER HEATING AND ELECTRIC HOUSE HEATING—By Samuel S. Wyer, Consulting Engineer. Columbus, Ohio: The Author. Paper; 6 x 9 in.; pp. 31.
Conclusions adverse; based largely on research and opinion published by Idaho Public Utilities Commission in 1918 and 1919.

SCIENCE AND COMMON SENSE IN WORKING WITH MEN—By Walter Dill Scott, President of Northwestern University; President of the Scott Company, Philadelphia; Formerly Director of the Committee on Classification of Personnel in the Army, and President of the American Psychological Association; Author of "Influencing Men in Business," etc. and M. H. S. Hayes, Member of the Scott Company, Philadelphia; Formerly Associate Psychologist, Laboratory of Social Hygiene; Joint author of "Delinquent Women in New York State." New York. The Ronald Press Co. Paper; 5 x 8 in.; pp. 154. $2.
Deals with means of judging the ability of men in different grades and in various branches of industry and business. Advocates and explains scientifically devised physical and mental tests, studies of character, history, and desires of individuals in relation to being hired for a new position or changed to one better suited to the man and woman. More of an argument for scientific tests tempered by common sense than an exposition of how the various tests should be made.

SEE UND SEEHAFENBAU — By H. Proetel, Regierungs und Baurat in Magdeburg, III. Teil. Wasserbau. 2 Band; Hand: bibliothek fur Bauingenieure, edited by Robert Otzen, Geh. Regierungsrat, Professor an der Technischen Hochschule zu Hanover. Mit 292 Textabbildungen. Berlin. Verlag von Julius Springer. Cloth; 7 x 10 in.; pp. 221. 40 marks.

THE SMITHSONIAN INSTITUTION: Annual Report, 1918-1919. Washington: The Institution. Cloth; 6 x 9 in.; pp. 557; illustrated.

SOPHOMORE ENGLISH FOR ENGINEERS—By D. B. Cofer, Associate Professor of Department of English, Agricultural and Mechanical College of Texas. College Station, Tex.: The Author. Paper; 6 x 9 in.; pp. 20.
Contains a short address by the author on "English for the Engineering Student," delivered in 1917; lists of (1) books and articles, (2) technical journals and (3) biographies for outside reading, oral reports, etc. The address is an able plea for the study of English literature and composition by prospective engineers for cultural and utilitarian purposes, with a few notes on current instruction in English composition at the Agricultural and Mechanical College.

STANDARDIZATION OF MEASURES OF LENGTH AT THE LABORATORY OF THE DOMINION LANDS SURVEYS—Ottawa, Ont., Topographical Surveys Branch, Department of the Interior. Paper; 6x9 in.; pp. 33; illustrated.

TECHNICAL EDUCATION IN RELATION TO RAILWAYS IN AMERICA—By H. L. Cole, O.B.E., M. I. Mech. E.; Locomotive Department, Indian State Railways, and Secretary, Railway Board. Technical Paper No. 219, Railway Board, Simla, India. Paper; 8x13 in.; pp. 46; illustrated. 14 Annas.

TECHNOLOGIC PAPERS OF THE BUREAU OF STANDARDS: No. 197, Cementing Qualities of the Calcium Aluminates—By P. H. Bates, Chemist, Bureau of Standards. Paper; 7 x 10 in.; pp. 27; illustrated. Washington, D. C. 10c. from Superintendent of Documents. Limited number free on application.

TRAINING FOR THE PUBLIC PROFESSION OF THE LAW: Historical Development and Principal Contemporary Problems of Legal Education in the United States, with Some Account of Conditions in England and Canada—By Alfred Zantainger Reed. New York: Carnegie Foundation for the Advancement of Teaching. Paper; 6x9 in.; pp. 498.

UNION SCALE OF WAGES AND HOURS OF LABOR, May 15, 1920—[Wages and Hours of Labor Series] Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 280.
Ninth annual bulletin on this subject. Gives union wages and hours of labor of 1,054,204 persons in 12 groups of trades in 66 cities; also gives for each trade the per cent increase of wage rates in 1920 over each of the 13 previous years for the cities collectively.

THE VENTURI FLUME—By Ralph L. Parshall, Senior Irrigation Engineer, Carl Rowher, Irrigation Engineer; Irrigation Division, Bureau of Public Roads, U. S. Department of Agriculture. Based on Experiments Conducted in the Hydraulic Laboratory at Fort Collins, Col., at Cornell University, and at the field laboratory at Bellevue, Col., under co-operative agreement between the Irrigation Division of the Bureau of Public Roads, U. S. Department of Agriculture, and the Colorado Agricultural Experiment Station. Bulletin 265 (February, 1921), The Agricultural Experiment Station of the Colorado Agricultural College, Fort Collins, Col. Paper; 6x9 in.; pp. 28; illustrated.
An article on the early history of this device appeared in *Engineering News*, Aug. 10, 1916, p. 271. In *Engineering News-Record*, Sept. 2, 1920, p. 452, P. S. Wilson and C. A. Wright dealt with the experimental work at the Cornell Hydraulic Laboratory. The general subject was further discussed by Julian Hinds, *Engineering News-Record*, Dec. 23, 1920, p. 1223.

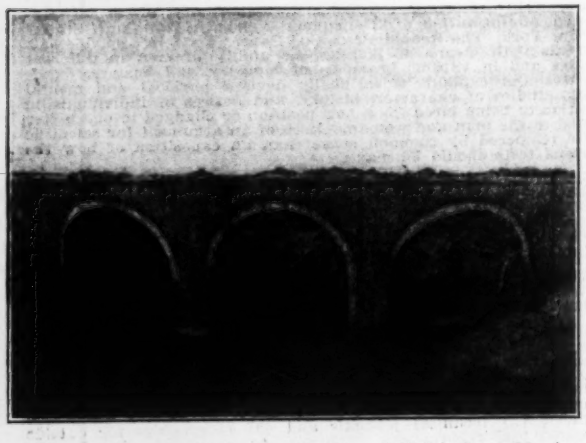
WATER RESOURCES OF KERN RIVER AND ADJACENT STREAMS AND THEIR UTILIZATION—Bulletin 9, California Department of Engineering, Based on Investigations in cooperation with Kern County, the Kern County Land Co., and the Tejon Ranch Co. Sacramento, Cal.: As above. Paper; 6 x 9 in.; pp. 209; eight separate maps and profiles.
The full utilization of Kern River is considered, including both power and irrigation uses, the development of storage and the utilization of ground water supplies.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Two Old Eccentric Arches

Sir—The illustration of an eccentric elliptical arch that appeared in a recent issue of *Engineering News-Record* prompts me in sending you a photograph of an old (perhaps ancient) aqueduct near the city of Chihuahua, Mexico, taken in 1899, in the belief that it may be of interest.



W. E. CONDON,
Taft, Cal. Civil Engineer.

Some Engineers Good Managers

Sir—"The Engineer a Failure as a Manager" offers another topic for extended and perhaps useful discussion.

Engineering News pointed out some thirty years ago that about 50 per cent of engineers with experience graduate from strictly engineering lines into executive positions. In view of old statistics and confirming data of a more recent date it does not sound reasonable to say that the engineer is a failure as a manager. Not all engineers are managers and not all managers are engineers, but executive positions have a persistent way of offering themselves to a goodly proportion of engineers.

No doubt the typical engineer as trained by experience or by our technical schools and experience is of a scientific and studious type, disciplined and conscientious; for him to be otherwise would be to deny his birthright. On the other hand imagination, vision and idealism are not the result of training but rather of inheritance and association. No good reason can be given why the engineer as a type should not have as large a degree of foresight as any other class. His collegiate training does not minimize idealism; why should his experience suppress this quality any more than the early novitiate which the lawyer and doctor serve? Was not James B. Eads inventive, imaginative and also a great manager? Ericsson had visions and realized on them in a most spectacular battle which revolutionized the navies of the world. George S. Morison was a great engineer and by no means a failure as a manager. Frank Thomson rose from surveyor to president of the Pennsylvania Railroad. He is generally considered to have been something of an engineer and one of the greatest railroad organizers of this or any other country. The history of the railway age will list a number of engineers who were managers with vision but not visionary.

The fact remains that our technical institutions have not helped seriously in training engineers to be managers, until very recently. We have courses in Business Administration, Engineering Administration, Industrial Engineering and no doubt they aid in developing engineers so that after due experience they may fill positions of an executive character better than without this training. The qualifications of a good manager are somewhat illusive and they develop with experience and usually with maturity. Whatever the difficulties may be they constitute no reason why the technical school should not consider the possibility of a training adapted more to the needs of a manager group where there is evidence of ability in that direction. It boots nothing to attempt to train all engineers as managers but it is important that the education of all engineers should be broad enough so that it does not hinder and does help them on their way to executive positions. Then some might well be given special training of a post graduate character and designed for the managerial type.

R. L. SACKETT,
State College, Pa. Dean, School of Engineering,
Nov. 4. Pennsylvania State College.

Dirt Is Not Earth

Sir—A correspondent of *Engineering News-Record*, Sept. 29, says in substance: "Few if any of our engineering institutions lay sufficient stress on the importance of an engineer's ability to speak or write the English language correctly."

We must agree with this statement when we read in college textbooks of the construction of "dirt" roads when earth roads are meant. Specifications from a State Highway Department contain the statement, "cover the shoulder drains with dirt." Good scholarship is offended by the use of the term, dirt, except in ordering its removal from materials.

The professional engineers are now engaged in making a drive to secure license laws in many of the States. Doctors and lawyers are not licensed, but admitted to the bar on a diploma or examination. We license peddlers, auctioneers and formerly saloon keepers. In Michigan engineers are not licensed, but are registered after an examination or producing proof of qualification for the work of engineer or architect. There are a few engineering magazines that use the so-called simplified spelling. In the opinion of your correspondent, not many really able engineers would care to have their manuscript mutilated in that way. It would seem that in the many years since the founding of this nation the steady influx of foreigners, representing every known tongue, would have corrupted the English language. Such might have been the result had not Noah Webster stood like a rock, defending and protecting our language as Washington defended and protected our liberties.

WINFIELD S. MERRILL,
Kalkaska, Mich., Oct. 14. Registered Civil Engineer.

Early Overloading of Concrete Floors

Sir—The writer is moved by certain articles which have appeared in your issues during the current year upon reinforced-concrete failures to express some conclusions which experience and observation have caused him to draw regarding reinforced-concrete design.

Probably no engineer will dispute the fact that it is not wise to permit green concrete in a building or other structure to be overstressed during construction. Collapse or failure may not occur, but the concrete is likely to be so damaged that it will give trouble later on by working and getting out of shape, although it may carry the load for which it is designed.

The loads which come upon the floors of such light buildings as office, hotel, apartment and school buildings, during the construction period are frequently much greater than any loads to which these same floors will be subjected after completion. When such floors are designed for a live working load of 40 lb. plus super-imposed dead-load of 20 lb., for example, they are almost certain to be overstressed by the construction loads. The contractor may be careful and conservative in handling his work, and the superintendent may be on the job and watchful, but brick, stone, sand or some other material will be piled on the floors and the damage done without the knowledge of those in charge of the work. There is a feeling prevalent among workmen

that reinforced-concrete floors will carry anything. Even though subcentering is placed throughout the building and kept in place as long as possible there comes a time when it must be removed so that work can proceed.

The writer believes that the floor slabs of buildings including joists and secondary beams should not be designed for less than 80 lb. per square foot live-load; and main girders for not less than 60 lb. per square foot as a minimum for any type of construction; for some types of construction these figures should be increased as much as 25 per cent. The columns of a building are not affected in the same way that the floors are by construction loads, and it is not necessary to be as conservative in designing the columns and column footings.

In determining the design live-load for floor slabs and beams there are several important points which should be carefully considered. A solid concrete slab which weighs say 80 lb. per square foot, and designed to carry a live working load of 80 lb. plus 20 lb. per square foot, may be loaded to 150 lb. per square foot and the material will be overstressed about 28 per cent. A light joist construction weighing 40 lb. per square foot and designed for the same working load, when loaded to 150 lb. per square foot will be overstressed about 36 per cent. If the live-load for which the two types are designed is 40 lb. instead of 80 lb. and each should be loaded to 120 lb. per square foot, the solid concrete slab construction will be overstressed about 43 per cent and the lighter construction about 60 per cent. This fact must be borne in mind by the designer and a larger live-load used in designing the lighter weight construction to provide against possible overloading of the floors during construction or after completion of the building.

The advantages of two-way and multiple-way reinforced-concrete slabs in carrying concentrated loads when compared with one-way reinforced slabs and beams, and to a still greater degree one-way joist and girder floor construction, are well known and appreciated by the engineering profession. This advantage must also be kept in mind by the designers of reinforced-concrete floors to provide for construction loads and also for possible concentrated loads after the building is completed. Girderless floors which carry the slab loads directly to the column need to provide for only the same loads that the main girders of a beam construction building would be designed. This follows as a matter of course.

The points herein brought forward should receive the consideration of those who are responsible for drafting building codes, and engineers who are responsible for the design of either reinforced concrete or steel buildings. It is not sufficient to establish minimum design loads without regard to the type of design that will be used.

It is entirely possible that if these matters are given their proper consideration there will be fewer failures of reinforced-concrete buildings. WALTER H. WHEELER,

Minneapolis, Minn., Oct. 22 Consulting Engineer.

Two Concrete Piers; A Lesson in Competitive Practice

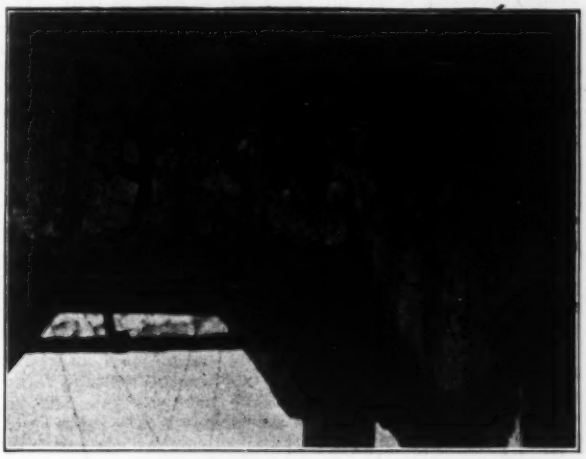
Sir—There are in Manila Bay two reinforced-concrete piers which constitute a most striking and forceful illustration of the advisability of following correct construction principles.

Piers "A" and "B" (a designation used for the purpose of this article), are both flat-slab and girder decks founded on precast concrete piles. They were built simultaneously in 1914, under almost identical conditions. They are located about two thousand feet apart and subject to the same sea action. Excellent trap rock and screenings from the same quarry and sharp clean sand, dredged from the Pasig River were supplied for each. The same brand of cement taken from the same shipments and warehouse, and fresh clean water from the same pipe were used throughout. Pier "A" is subjected to vastly greater traffic than is Pier "B."

Pier "A," after seven years' hard service, is in splendid condition. A careful survey reveals no sign of serious concrete deterioration, nor rupture due to oxidized reinforcement. There are a few rust stains.

Pier "B," after the same length of service, is in an advanced state of disintegration. At least seventy-five per cent of the deck beams are cracked and spalled, many so seriously as to expose the entire side and bottom of the reinforcing. The bottom of the floor slabs and the pile haunches have spalled, exposing the steel in many places. Many other places, particularly on the bottoms and sides of the main floor beams, are cracked and bulged. A chisel inserted in a crack will bring off great flakes of concrete exposing steel which in every case is heavily corroded. The concrete appears to be of excellent quality. The floor slabs, beams and haunches are strained with rust. The concrete piles which were precast in special forms are in excellent condition.

Here we have two piers built under identical circumstances, one in perfect condition the other failing rapidly.



RUSTED STEEL CAUSES CONCRETE BEAM FAILURE

The answer? It is simple, simply this. The superintendent who built pier "A" used common sense. The builder of "B" violated two of the most fundamental principles of reinforced-concrete construction, particularly vital where the work is exposed to sea water.

When the steel was delivered to both piers, it was found to be incorrectly bent. The beam stirrups were too large and the longitudinal beam rods were bent too high. The superintendent on pier "A" stopped his job, and re-bent his steel. The superintendent on pier "B" was too busy to do likewise, so put the steel in as it came.

The serious damage to pier "B" is unquestionably due to heavy corrosion of the reinforcing steel because it was placed too closely to the surface of the concrete. Measurements taken at many places show that it was embedded but from ¾ in. to 1¼ in., which is entirely insufficient cover. This is an excellent illustration of the vital importance of deeply embedding the steel in rich impervious concrete, on all work which will be exposed to the action of sea water or salt air.

Another contributing cause of this failure was undoubtedly the practice in vogue on pier "B" of pushing the portable mixer, with piles of cement and aggregate out onto the new floor slabs within a day or two after they were poured. The vibration of the running mixer on this setting concrete was sure to open hair cracks, and weaken the bond between the concrete and steel. It is a practice to be condemned utterly on this class of work.

The writer has just finished two concrete piers in the same neighborhood. Portable mixing plants were used on each, which were not allowed to move out on a new piece of deck until it had been poured two weeks. As the piers were built out from the shore end this involved considerable wheeling of concrete.

Extreme care was exercised to the end that no portion of the reinforcing steel should approach nearer than 1½ in.

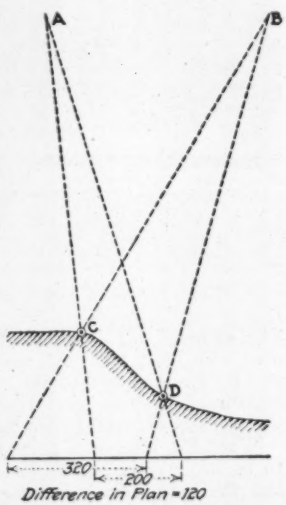
to the surface of the concrete. It is believed that this is insufficient for safety and permanence under conditions which obtain in tropical waters, particularly if the concrete will be exposed to any abrasion. The minimum depth of rich impervious concrete, measured to the nearest surface of the steel should be not less than 2 in.

Manila, P. I., Aug. 6 H. H. BRAUN,
Engineer-Contractor.

Some Weaknesses of Aerial Photo Maps

Sir—The article published in *Engineering News-Record* of Oct. 13, p. 596, on aerial photographic mapping is interesting so far as it refers to reconnaissance surveys, but when the writer attempts to show that photography may be substituted for ground methods of accurate surveying he is exceeding the limit of his subject. The principles of astronomy, trigonometry, geometry, geodesy and perspective cannot be consigned to oblivion as superfluous by simply pressing a button. It is not so easy as that. The use of aerial photographs for surveying has been investigated in Europe before and during the war—and the results achieved only served to demonstrate what was already well known to many surveyors, that for all practical engineering purposes the making of maps from photographs is impossible.

There are many things in the article referred to which would not stand the test of practical demonstration, but a reference to one or two may be sufficient to show the general debility. "Negatives, . . . by enlargement or reduction, can be brought to a uniform scale even though the airplane from which they are taken does not fly at a constant altitude." The perspective, or photographic distance between two points, may differ considerably from the horizontal, or plan, distance according to the shape of the ground and this cannot be adjusted by merely reducing or enlarging the picture. Nor will the correct altitude of the airplane with reference to one or two points be sufficient; the elevation of all points to be plotted must be ascertained with relation to a known datum, and if this cannot be done the picture will merely be a sketch map without a scale. In rolling or hilly country this is more noticeable. The altitude of the airplane is not the governing factor as may be seen from the diagram. The first position of the airplane at *A* overlooks two points, *C* and *D*, which are projected on the photograph, or picture plane, 200 ft. apart; the second position of the airplane, *B*, at the same altitude, projects the same two points, *C* and *D*, on the picture plane 320 ft. apart. This is only one of many discrepancies not referred to by aerial survey enthusiasts and it would be interesting to learn how such remarkable closures as "an error of less than one-half of 1 per cent" are arrived at. The city of Rochester may be on very level ground, but other results cannot be so easily explained.



The excerpts taken from the report of an "engineer" commencing—"An aerial map of the city would show more detail than we could ever hope to put on any plan prepared from surveys," etc.—become mere nonsense when compared with the photographic reproductions.

The last paragraph is very disheartening, when we consider its application to any of the photographs shown, and they must have been picked ones. "By placing tracing paper over the complete mosaic, all information desired may be traced off, thereby giving a line map without the photograph showing." Imagine the feeling of a draughtsman who was asked to make a ground line plan on tracing of the photograph on p. 597! He might get a little work done in the center of the picture, but outside of that it would be a hopeless task. Look at the E-shaped building, for instance, at the crossing of Park Ave. and 34th St.; judging by the roof there would appear to be 12 corners, but only one is visible on the ground line. The outer part of the picture is not in plan at all and would have to be treated as "oblique"—if, indeed, it was worth it.

The use of aerial photographs for making accurate plans is a very difficult proposition, but if we require relief, or contour, maps they cannot be considered in any shape or form.

The day of the airplane as a surveying instrument has not yet arrived, and the "old field tools" referred to in your editorial will have to be used for many a long day before a substitute is found for reliable mapping.

Winnipeg, Oct. 24. P. J. BARRY,
Dominion Water Power Branch, Department of the Interior, Canada.

Problems in the Chlorination of Water

SIR—The answers to Q. 9 in "Problems in the Chlorination of Water," *Engineering News-Record*, Sept. 15, p. 444, show a wide difference of opinion among plant operators. I believe this subject should be discussed further. The question was stated as follows: "Does the bacterial reduction effected by an excessive use of chlorine warrant letting down on the possible efficiency of filter plants? In other words, should filter efficiency be allowed to drop with the idea that the bacterial efficiency may be raised by a liberal use of chlorine?"

I believe that the question could have been better stated. The implication of inefficient plant operation is one that few operators would admit and justly so, if due to an intentional low percentage of bacterial removal by their filters. Also the wording "excessive use of chlorine" is ill advised. The question is better stated in the editor's note preceding the first article, p. 392, Sept. 8 issue, "Should plant operators strive less to produce a low bacterial count by filtration, relying on chlorine for that, and try to get 100 per cent clarification as economically as possible?"

In many cases the answer to this question should be "yes." Mr. Armstrong says that "the efficiency of a filter plant should not be lowered in any respect with the idea of making up for careless operation by the use of chlorine." Note his phrasing: "careless operation." The operator who can produce the same results from a plant at a lower cost per million gallons than the one using a larger dose of coagulants is a "careless operator" because he does not get as high a percentage bacterial removal on the filters. I believe the way this question was put influenced Mr. Armstrong's answer.

Many of those who favor dosing the water with chemicals so as to obtain an effluent from the filters of satisfactory sanitary quality regardless of the chlorine treatment seem to feel that reliance on the chlorine treatment is not a safe expedient. This is probably true for the plant that relies on one chlorinating outfit, because chlorine tanks become empty and are not always immediately replaced. The apparatus may get out of order and then the water does not receive the proper does of chlorine, thus making chlorination intermittent. In advocating economical operation by obtaining 100 per cent clarification by means of the filterr and the necessary sanitary quality by the use of chlorine, please give operators credit for insisting (1) on the filter beds and mechanical equipment being maintained in first class operating condition; and (2) on the chlorinating apparatus being so subdivided that the mechanical failure of one unit, the emptying of one cylinder without immediate replacement, will not reduce the chlorine dose below the point necessary to obtain a water of good sanitary quality.

It has been my experience that the chlorinators on the market are reliable and, if intelligently installed and operated in duplicate or multiple units, can be relied upon. Many large water supplies not filtered are successfully

and safely chlorinated by this arrangement. The cost of the equipment is small when compared to the total investment in the plant. Good engineering practice should then call for at least the duplication of the chlorinators. This overcomes the objection due to unreliability.

If the plant operators owned their plants and had to pay for the coagulants out of their profits, I do not believe they would advocate the use of more coagulant than was necessary for 100 per cent efficiency in clarification except under certain conditions mentioned later.

Some plants are fortunate in producing satisfactory effluents part of the time when dosing with just enough coagulant to obtain a good clear effluent from the filters. Others, producing a clear effluent but not a water of satisfactory sanitary quality, are troubled with odors or tastes due to the chlorine dose necessary to give the desired bacterial content. Whether this is due to primary chlorine tastes or to secondary tastes and odors due to trade wastes in the water, it is obvious that in this latter case the coagulant does should be regulated so as to obtain the necessary bacterial reduction on the filters. However, the latter case is special and does not represent the results obtained in the majority of plants.

Consider a hypothetical filtration plant representing approximate average filter plant conditions: Assume that 200 lb. of alum per million gallons are necessary to produce a clear sparkling effluent, regardless of the bacterial content; that 300 lb. would be required for an effluent of good sanitary quality, and when using 200 lb. of alum 2 lb. of liquid chlorine per million gallons would be necessary to reduce the bacterial content to the same value as would be obtained without chlorine but using 300 lb. of coagulant per million gallons. Operator 1, using 200 lb. of coagulant at 2c. and 2 lb. of chlorine at 8c., saves $1.84 per million gallons. If the 16c. used for chlorine were spent on coagulant, he would be able to use only 208 lb. Operator 1 is saving money but the consumer must be the first consideration of the operator. Both the public health and the public pocketbook should be considered since the consumer is ultimately the one who pays the bill.

Suppose, in this hypothetical filtration plant, that Operator 1 doses the water with 2 lb. of liquid chlorine just as it leaves the filters, then later on just before it reaches the pumps he gives it another 2-lb. dose of chlorine. The first dose of chlorine produced an effluent equal to that obtained by Operator 2 with 300 lb. of coagulant and the second dose produced approximately the same factor of safety that Operator 2 obtains by the use of 2 lb. of chlorine. Of course, the same effect would be produced by Operator 1 applying the chlorine all at one point. The comparative costs would then be: first operator, $4.32, and second operator, $6.16. Again the first operator saves $1.84 per million gallons.

If Operator 1 were in charge of a plant handling water requiring a large dose of chlorine to give a satisfactory plant effluent and could not double the dose on account of chlorine tastes in order to obtain the necessary factor of safety to take care of the failure of one chlorine apparatus, then the solution in this case would be the use of more chlorinators. If it were necessary to apply 3 lb. per million gallons to reduce the bacterial content to the desired point four chlorinators could be put into service, each dosing the water at the rate of 1 lb. per million gallons per day. The failure of one outfit would not have a serious effect on the quality of the water.

At the Akron filtration plant three chlorinators are installed. Two are kept in constant service, the output from each being regulated so as to be equal. Hourly reading of the weights of the chlorine tanks are taken and recorded. The third chlorinator is kept in reserve. During the past three years it has not been necessary to put the third machine into service. So much for reliability of equipment. The average yearly dose of liquid chlorine has been a little over 2 lb. per million gallons. During certain periods over 4 lb. per million gallons are used.

The editor's statement that "the consumer is the first consideration of the operator," and that "he must continually balance the public health against the form and economy of treatment," is true, but should not be used as a cloak for an inefficient business administration.

It is daily being demonstrated that it is possible with safety to the consumer to operate filtration plants to obtain 100 per cent clarification and the desired color removal, relying on the chlorine treatment for the bacterial removal. This being the most economical form of operation, it seems to me that it is the method that should be followed, except in the few special cases where trouble is encountered due to primary or secondary tastes or odors. An exception should also be made for those plants handling water subject to sudden changes in turbidity or pollution and not having large storage basins between the filters and source of supply.

Before the introduction of the use of liquid chlorine, polluted water was filtered so as to obtain a safe potable product. With the same or greater factor of safety as formerly, and with considerable reduction in operating costs, we can, by the intelligent use of liquid chlorine, supply the consumer with safe, potable water. If chlorination is resorted to as a precautionary rather than a primary measure, we are not making full use of the knowledge or science at our command.

J. S. GETTRUST,
Kent, Ohio, Oct. 11. Superintendent of Filtration.

Paint Research Not Lacking

I have seen Prof. A. H. Sabin's letter of Aug. 5, appearing in your issue of Aug. 18, p. 291. I have noted his suggestion that research work on paint be started at the Forest Products Laboratory. Such work has been under way at the above named laboratory for several years.

Prof. Sabin's reference to the difficulty of obtaining railroad specifications is also noted. He must know that there exists in Washington an interdepartmental committee on paint specification standardization. This committee, which by the way includes engineering representatives of the highest type from various railroads, has drawn up specifications for the various ingredients used in paints, as well as specifications for paste and prepared paints, used by the railroads and by the various departments of the United States Government. These specifications are obtainable, in the form of circulars of the Bureau of Standards, from the U. S. Government Printing Office. They are being widely used throughout the United States.

The writer of an editorial in *Engineering News-Record* in connection with Prof. Sabin's article (p. 262) has apparently been misled by the article referred to. For instance, he makes the following statements:

"But the entire subject of the physical action of paint coatings is closely related to the specific case referred to, and is as much involved in ignorance. Nor is there any more knowledge on the chemical problems of paint, as in fact is directly suggested by a second case which Prof. Sabin cites to support his argument."

"Among paint users there has always existed an undercurrent of belief that paint is a field of mystery. . . ."

"Such a general confession would be a significant piece of progress. It would remove one of our great industries from its state of medieval mystery and put it on a plane of scientific knowledge."

The writer of the above editorial is probably not familiar with the fact that the Paint Manufacturers' Association of the United States was undoubtedly the first industrial organization in America to undertake scientific research on a co-operative plan. This work was started as early as 1907, when the laboratories were organized and an extensive series of exposure tests inaugurated. During recent years the National Varnish Manufacturers' Association has joined in this same work, which is now conducted at the writer's laboratory in Washington. The results of the work are published monthly in the form of pamphlets for the benefit of the trade at large and for the consumers of paint as well. These publications have from time to time been issued in the form of books, several of which have been published by the McGraw-Hill Book Co. of New York City.

Washington, D. C. H. A. GARDNER,
Oct. 20. Institute of Paint and Varnish Research.

HINTS FOR THE CONTRACTOR

Mixers on City Paving Work Charged by Batch-Box Method

BY T. W. DIECKMAN
With the Lakewood Engineering Co., Cleveland, Ohio

SEVERAL Detroit contractors, including Thomas E. Currie, J. A. Mercier and Julius Porath, have developed a method of using batch boxes to charge paving mixers on city street work. This gives the following advantages: Eliminates the wheeling and shoveling crew; prevents damage to the finished subgrade, because materials are not hauled over it in wagons or trucks; and stops losses of material because none is piled directly on the subgrade—when materials are placed on the subgrade, contractors usually take a loss of 5 to 10 per cent on sand or stone, since it is not possible to clean up all of it.

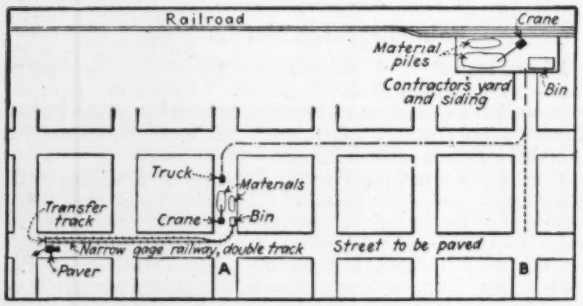


FIG. 1. BATCH-BOX SYSTEM WITH MOTOR TRUCK HAULAGE

Streets to be paved shown cross-hatched; transfer points located, in turn, at A, B and C

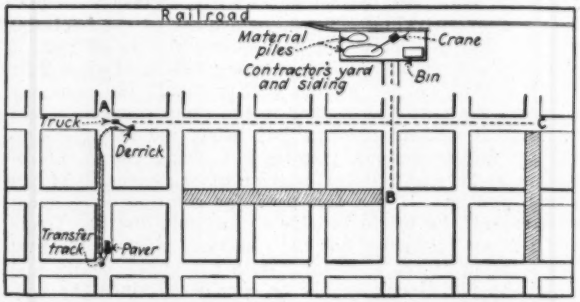


FIG. 2. LAYOUT WHEN BULK HAULAGE IS EMPLOYED

Transfer point first at A, then at B.

Sand and stone, unloaded by crane or other means at the contractor's siding, is hauled either in batch boxes on motor trucks or in bulk by motor trucks to the end of the street to be paved, or to some convenient cross street intersection. A short stretch of narrow-gage track is laid on the subgrade from this point to the mixer. If the material has been hauled in batch boxes on motor trucks, they are lifted directly on to the narrow-gage cars by a small crane, or, if the material has been handled in bulk, it is dumped on the ground or pavement and rehandled into a small portable bin by a crane or bucket elevator. The narrow-gage cars carrying batch boxes are run under this bin, charged with the proper amount of sand and stone and hauled by gasoline locomotive to the point where work is in progress.

The track is really laid as a double track from the mixer back to what is considered about a day's run. At the mixer end of this double track there is a transfer track which is a simple contrivance for moving the cars and empty batch boxes from the inside track next to the paver over to the outside track. This transfer track consists of two pieces of rail just long enough to carry the car. They are set to the track gage and are fastened on angles carrying four rollers which run in channels and allow the transfer to be moved easily from one track to the other. The transfer is mounted on a wood frame, which can easily be picked up and moved as the concreting advances. Generally a 5-car train is used; three sets of trains, or a total of 15 cars is usually required. This means that there is one train at the mixer, one at the bin or transfer point, and one in transit.

When the last batch is used from the train at the mixer, the locomotive is already there with another train of 10 batches on the inside track. These are placed, the locomotive uncoupled and backed on a switch to the outside track to pick up the empties. These are pulled down to the switch ready to be placed at the bin or transfer point as soon as the loading of the train previously placed there is completed. This method of operation insures that the mixer is at all times supplied with sufficient material to operate continuously.

At the mixer the batch boxes are lifted off the running gears by the batch transfer of the paver and are swung over the skip where the material is dumped. No sand or stone is placed upon the finished subgrade, and no wagon or truck haul can damage the grading after its completion.

With this method only 3 men are required to charge the paving mixer, while with wheelbarrows a crew of about 18 would be needed. When material is dumped on the subgrade, 5 to 10 per cent of it is lost because it cannot be cleaned up. With the method here described the material never touches the subgrade, and this means a further saving to the contractor. No hauling is done over the finished subgrade, so that there is no extra cost for retrimming the subgrade. This cost of retrimming only 25 per cent of the area at 10c. per square yard, would amount to $400 per mile of 30-ft. street.

If batch boxes are hauled on motor trucks out to the street to be paved, bulk cement may be used, which will make an economy of at least 15c. per barrel, which is about $550 per mile of 30-ft. street. If bag cement is used, bags will all be handled in one place, instead of being carried out to the mixer to become lost.

A great advantage of the system is its ability to operate in weather which would close down other methods. A wet subgrade is no bar to operation. In the opinion of many contractors who have used this method, its ability to continue construction under weather handicaps is its biggest asset.

NEWS OF THE WEEK

New York, November 17, 1921

British View of Depression and Recovery Measures

Lower Bank Rate Needed for Trade Revival—Foreign Markets Discussed

In a report to the Prime Minister the executive committee of the Federation of British Industries has given its views on the causes of the present depression and on remedial measures. The suggestions include a reduction in direct taxation, export credits, loans to the Crown Colonies and the Dominions. There are views, too, on exploitation of foreign markets which have a special interest for Americans.

The fundamental causes of the depression are set down as: 1. The general impoverishment of the world, owing to the enormous unproductive expenditure. 2. The destruction of the world's standards of value, due to inflation of currencies. 3. An alteration of the world's trade channels, due to (a) the partial or complete disappearance of many pre-war markets and sources of supply and (b) the development of industries in countries which formerly exported raw materials and imported manufactured goods.

As a result there will be, first, a period during which there will be serious hindrance to international trade and, second, a longer period, which will last until the destruction of goods and means of production has been made good by hard work and restricted consumption.

STABILIZE THE EXCHANGES

Looking to amelioration of conditions in the first period it is stated that the first necessity is to stabilize the exchanges. To this end it is suggested that Great Britain join with one or more strong powers to impose a common currency policy on the rest of the world. Pressure would be brought to bear through the extension or withholding of credits, the manipulation of international debts in some cases, the reparation payments and, in the event or extreme recalcitrancy, an economic boycott. The ends to be sought would be a cessation of inflation and a balancing of budgets, followed by stabilization of currencies and "re-anchoring them to gold, though not necessarily in the same ratio as their pre-war currencies." It is suggested, also that similar pressure might be exerted to induce countries "which are constantly varying and raising their tariffs" to lower them or at least to stabilize them.

As to remedial steps affecting both periods the consideration is urged of a lowered Bank rate, to induce trade revival; an immediate and substantial reduction of direct taxation is declared to be imperative; export credits as a means of developing markets not too severely affected by the war are suggested, as are, also, loans to enable the Crown Colonies and Dominions to develop their territories. It is recog-

(Continued on p. 832)

President Signs $75,000,000 Federal-Aid Road Bill

New Act Makes $25,000,000 Immediately Available—$15,000,000 for Forest Roads—Event Marked by Special Ceremony

President Harding affixed his signature to the highway bill Nov. 9, thereby making $25,000,000 immediately available for distribution among the states for federal-aid road projects. The remaining $50,000,000 carried by the bill will become available Jan. 1. In addition $15,000,000 is made available for forest roads and trails during the next two years.

The signing of the bill was accompanied by more than the usual ceremony, so that a motion picture could be made of the event which marks the establishment of an important precedent in the government's highway policy. There was a preliminary statement by W. C. Markham, of the Kansas Highway Commission, who has been acting as the legislative representative of the American Association of State Highway Officials throughout the consideration of the bill. His remarks were followed by a statement from the Secretary of Agriculture, who pointed out that the bill contains provisions for road maintenance, which should meet the full requirements specified by the President in his message to Congress. Senator Townsend then handed a specially wrought pen to the President who signed the engrossed bill. Others who participated in the exercises incident

HOW FEDERAL-AID HIGHWAY FUNDS WILL BE APPORTIONED AMONG THE 48 STATES:

State	Allotment
Alabama	$1,553,420.67
Arizona	1,053,281.44
Arkansas	1,254,142.20
California	2,462,098.53
Colorado	1,341,175.69
Connecticut	480,897.78
Delaware	365,625.00
Florida	886,825.69
Georgia	1,997,957.58
Idaho	938,536.68
Illinois	3,246,281.07
Indiana	1,958,855.41
Iowa	2,102,872.74
Kansas	2,102,281.51
Kentucky	1,417,178.68
Louisiana	996,989.64
Maine	695,160.25
Maryland	640,629.01
Massachusetts	1,096,176.04
Michigan	2,249,532.43
Minnesota	2,123,597.07
Mississippi	1,294,906.22
Missouri	2,448,128.62
Montana	1,546,885.82
Nebraska	1,581,189.50
Nevada	953,436.78
New Hampshire	365,625.00
New Jersey	942,870.95
New Mexico	1,189,823.34
New York	3,696,447.97
North Carolina	1,709,333.90
North Dakota	1,164,714.42
Ohio	2,823,004.05
Oklahoma	1,752,339.44
Oregon	1,182,663.99
Pennsylvania	3,398,953.97
Rhode Island	365,625.00
South Carolina	1,061,237.34
South Dakota	1,204,060.31
Tennessee	1,647,692.24
Texas	4,425,172.41
Utah	849,417.21
Vermont	365,625.00
Virginia	1,456,828.47
Washington	1,103,709.77
West Virginia	802,359.77
Wisconsin	1,894,815.86
Wyoming	934,617.63

Agree on Paving Brick Standards

Representatives of engineering societies and paving brick manufacturers met Nov. 15 in Washington, D. C., with officials of the Department of Commerce and agreed to recommend to the several engineering societies the approval of eleven varieties of paving brick as standard, thus eliminating all the remainder of the 66 varieties now current. The 11 varieties recommended, all of them 8¼ in. long, include only four sizes, 4 x 3¼ in.; 3 x 4 in.; 3¼ x 3¼ in. and 3 x 3¼ in. Details of the deliberations and conclusions will be published next week.

Seven Bidders for Big New York Subway Contract

Bids were opened by the New York Transit Commission, Nov. 9, for the construction of the extension of the Queensboro subway from its present terminal at Grand Central Station to the west side of 8th Ave. Seven bids, all from New York firms, were received as follows:

Powers-Kennedy Contracting Corp., $3,839,000; Keystone State Construction Co., $3,895,000; F. L. Cranford Inc., $4,171,000; Patrick McGovern, Inc., $4,235,000; Booth & Flinn, Ltd., $4,389,000; Rodgers & Hagerty, Inc., $4,800,000; T. A. Gillespie Co., about $5,000,000.

In advertising for bids the Commission's engineer estimated the probable cost of this extension at $4,000,000 upward.

Prizes for Papers Offered by Illinois Society

Following the practice initiated last year, the Illinois Society of Engineers is offering five prizes of $25 for papers in five fields of engineering work: Drainage, sewerage, roads or street paving, surveying and miscellaneous civil or municipal engineering. To encourage the younger members, the competition is limited to those who have been members of the society for not more than five years, and is open also to candidates for membership. Papers, prepared according to prescribed rules, must be submitted by Jan. 1, 1922, and the prize papers will be read at the annual meeting at Decatur, Ill., Jan. 24 to 26. Particulars of the terms of the competition may be obtained from the secretary of the society, E. E. R. Tratman, Wheaton, Ill.

to the filming of the ceremony were John M. Parker, Governor of Louisiana; Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads; the senators and representatives making up the conference committee which perfected the bill and Paul Wooton, Washington correspondent of *Engineering News-Record*.

British View of Depression

(*Continued from p. 831*)

nized that these plans might involve further borrowing, and thus increase the cost of these schemes over their financing out of taxation, but it is suggested that, "this expense might well be repaid by a more rapid return of prosperity."

The work to which the suggested Dominion loans would be devoted would be state-aided immigration schemes, based on agricultural assistance. Such schemes would furnish a market for British products and also relieve the pressure of surplus population in Great Britain.

Even if all these remedies should be applied—and with success—a long period of restricted world trade is forseen. Full employment can be obtained in Great Britain during that period only if the country secures a larger proportion of the world's trade than she had before the war. Discussing the possibility of obtaining this larger proportion the report says:

COMPETITION IN FOREIGN MARKETS

"It seems probable that circumstances will to some extent assist us in this, since the creditor position of the U.S.A., coupled with the maintenance of a high tariff, makes it extraordinarily difficult for them to develop competition as against ourselves in foreign markets. At the same time it is possible that the financial and other difficulties of our European competitors will in the long run so impair their productive power as to render them less formidable competitors for some time to come than the temporary effect of the exchanges is leading us to consider them at the present time.

"In this connection it is interesting to note that there are already signs that Germany, the most formidable of these competitors, may already be becoming a less important factor. They have obtained substantially fewer foreign orders at recent international fairs, such as Leipzig and Utrecht, than they obtained last year, and there are some reports from countries adjacent to Germany that they are failing to deliver goods ordered some months ago, and that in some cases additions have been made to prices previously agreed upon.

"These indications are very slight at present, but tend to confirm the belief that the present competitive power of Germany is based very largely on artificial and temporary conditions, which must in course of time disappear, these temporary conditions, of course, being the continued inflation of German currency and the direct and indirect subsidies to the cost of living to which are due in part the lower labor costs in German manufactures."

Concluding the report are these comments on the matter of lowered costs of production:

"However favorably all or any of these causes may work for us, they can only diminish the problem. We have got to realize that if we are to sell goods to an impoverished world we must sell them at a price which that world can afford to pay, and that if foreign labor costs are below ours in any trade, either through their workmen accepting lower rates of remuneration than ours, or giving higher efficiency for similar remuneration, no artificial measures will enable us to continue to give employment in that trade.

"The lowering of the cost of production involves, of course, two factors. The first is the improvement of management, organization, and plant, and requires time, and above all the expenditure of capital, which the war and present taxation and the diminution of the world's capital resources will render it extraordinarily difficult to supply.

"The second factor is either an increased efficiency of labor in proportion to its remuneration or decreased remuneration without a decrease in efficiency. The choice before the country is to reach this result either by agreement, which would be infinitely the quickest and most satisfactory to everyone concerned, or by the sheer force of circumstances — continued unemployment, continued distress, and in the ultimate resort starvation for the workman and bankruptcy for the employer."

"Hydro" Presents Alternate St. Lawrence Scheme

At Ottawa on Nov. 14 the Hydro-Electric Power Commission of Ontario, through F. A. Gaby, Chief Engineer, laid before the International Joint Commission an alternate plan for the development of power on the St. Lawrence to replace the Wooten-Bowden scheme, noted in *Engineering News-Record*, Sept. 8. The new plan calls for two series of dams and power houses and is claimed to produce 1,600,000 hp., or 100,000 hp. more than the joint report, by a concentration of dams in the Long Sault and a minor plant near Morrisburg. Another plan was presented by W. S. Connolly, representing the New York & Ontario Power Co., for a development between Morrisburg and Waddington. At the same hearing Hugh L. Cooper, of New York, presented some engineering objections to the Wooten-Bowden plan.

New York Pier Extension Allowed, Pending New Work

By order of Secretary of War Weeks the City of New York is permitted to continue the 100-ft. extension of the piers in the Chelsea district of the North River until longer piers are provided farther up the river. This is a controversy of long standing and by order of the Secretary of War some months ago the Chief of Engineers U. S. Army, was required to shorten the two piers in question because of their menace to navigation. The city promises that longer piers will be immediately provided in the 48th St. district in the North River and contends that until such long piers are provided there will be no place where ships of the "Olympic" and "Aquitania" type can dock. On this plea the Secretary of War has granted a further extension of time.

Paterson Votes to Acquire System of Water-Works

By a vote of about 20,000 to 3,000 the electorate of Paterson, N. J., declared for municipal ownership of water-works on Nov. 8, but for no specific plan. The present supply is from the Little Falls filter plant on the Passaic River, owned by the East Jersey Water Co. and allied interests, which also own the Paterson distribution system. A similar vote in favor of municipal ownership was cast in 1910.

On the same date Paterson voted 16,000 to 7,000, against abolishing its Board of Public Works and vesting the powers and duties of the board in the City Council.

Begin Work on Industrial District for Dallas, Texas

The contract for all grading work in the new Texas & Pacific industrial district at Dallas, Texas, was let early this month and all track work is expected to be completed by Jan. 1. This district was given to the Texas & Pacific Ry. Co. in exchange for the removal of their main line from Pacific Ave., and is the result of city planning work suggested by the city's consultant, George E. Kessler of St. Louis. The total cost of the project, exclusive of the cost of the land, will be $125,000.

For the St. Lawrence Waterway

At a joint meeting of the four national engineering societies at New York City on Nov. 14 the arguments favorable to the St. Lawrence waterway and power development plan were presented by a distinguished group of speakers. The meeting was presided over by W. L. Saunders, past president of the American Institute of Mining and Metallurgical Engineers who turned the introducing of speakers over to Julius Barnes, head of the U. S. Grain Corporation during the war. The speakers were H. I. Harriman, president of the New England Power Co., Boston; Gov. Henry J. Allen, of Kansas; ex-Gov. W. L. Harding, of Iowa; and Roy S. MacElwee, recently chief of the Bureau of Foreign and Domestic Commerce.

Mr. Barnes and Mr. Harriman laid the basis of argument favorable to the proposed project in explicit terms, but the hit of the evening was made by Governor Allen, who chose to state the position of the Middle West by controverting a recent speech of Governor Miller of New York, in which the latter attacked the St. Lawrence project. In answer to the New York governor's claim that the Barge Canal would answer every purpose of navigation hoped to be served by the St. Lawrence waterway, Governor Allen said: "We are bound for Liverpool, not Buffalo,"—a concise statement of the whole pro-St. Lawrence argument.

At the outset of the meeting Mr. Saunders read a letter from various New York bodies asking that the engineering societies set aside a day for the expression of arguments against the waterway. Mr. Saunders stated that Governor Miller had been asked to this meeting but had declined.

There was a large attendance at the meeting, the main auditorium of the Engineering Societies building being filled to overflowing.

Drainage in One Missouri County To Cost $1,172,556

Ten projects for the drainage of marsh and sour lands in Grundy County, Missouri, aggregate 82 miles of large ditches to reclaim 55,680 acres at a cost of $1,172,556. With a cost of $20 to $30 per acre the land value is expected to be increased by $40. Two projects are completed, three are under contract, and five are in the preliminary stages, the estimated cost of these five being about $625,000.

Joseph Stewart, Trenton, Mo., is engineer for the Sugar Creek and two Medicine Creek drainage districts; M. H. Mooney, Trenton, Mo., engineer for Grand River drainage district No. 1, and M. Hazen, St. Joseph, Mo., engineer for the Brimson drainage district. Of the work under contract, McWilliams Dredging Co., Chicago, has 485,000 cu.yd. for the 10-mile Muddy Creek ditch; the Rinehart Construction Co., St. Joseph, Mo., has the Wilson Township ditch, and the Sampson Construction Co., St. Joseph, Mo., has 422,000 cu.yd for the 18-mile Honey Creek ditch.

Iowa Water-Works Section Against Raising Pressure For Fires

Serious objections to raising water pressure above the normal during fires were raised at the meeting of the Iowa Section of the American Waterworks Association Nov. 1-3, at Omaha. The section declared by resolution that the method was an undesirable practice and that the use of motor pumpers or other auxiliary apparatus be extended as rapidly as possible as being more suitable and economical. C. R. Henderson, manager, Davenport Water Co., stated that an excessive pressure during a fire was a mistake, due to the likelihood of breaks in mains at a critical time.

In the resolution passed are the following points: An increase of pressure in itself results in more water being discharged through the numerous leaks which always exist and more water being used through fixtures, in damage to plumbing, in the breaking of service pipes, and at time, the breaking of large water mains, all at a time when the whole water supply should be strictly conserved. Accidents to pumping machinery and valves are more apt to occur, and do occur, under the additional strain and during the excitement of raising fire pressure. An increased pressure ordinarily requires that water stored in elevated reservoirs be shut off during fires, and so made unavailable, in order to permit of direct pumping into the mains, resulting in an extra burden being placed on filter plants, and consequent danger of an epidemic following a conflagration.

In handling fires in high buildings and in the case of other serious hazards, fire departments now require large and powerful streams far beyond the capacity of domestic waterworks systems to supply. Such streams and such pressure can be furnished by motor pumpers without the hazard of raising pressure in the city mains, making more and shorter lines of hose available without the heavy expense for equipment and operation formerly required in the case of steam fire engines.

Suggest Commission of Engineers on Denver Water Problem

The Denver Civic and Commercial Association has proposed to the Municipal Board of Water Commissioners that a commission of three engineers be appointed to study and report upon the needs of the water system, with a view to inspire the citizen with confidence as to the necessity of a bond issue. The association recommends one consulting engineer of national prominence, a prominent government engineer acquainted with the water supply problem of the Rocky Mountains, and a local engineer of standing and experience. The names suggested, from which the water board might choose, are as follows: James H. Fuertes, Dabney H. Maury, and Nicholas S. Hill, Jr., for the consulting engineer; Arthur P. Davis for the government engineer; Herbert S. Crocker, L. G. Carpenter and F. C. Steinhauer for the local engineer.

Ten Hetch Hetchy Headings Advanced 4060 Ft. in October

In October the 10 headings of the mountain division tunnels of the Hetch Hetchy water supply system for San Francisco were driven by the Construction Company of North America, a total of 4,060 ft. This is the highest monthly progress yet made on the project. In the total of 679 shifts worked in October the average heading advance was 5.98 ft. The number of holes in each round varied from 25 in altered slate and schist to 50 in monolithic granite. On Nov. 1 a total of 45,073 ft. had been driven leaving approximately 50,000 ft. to go. The date on which the tunnel driving will be completed is now estimated to be about March, 1923.

International Chamber To Meet in Rome

Announcement was made recently by the American section that the second annual meeting of the International Chamber of Commerce will be held in Rome, Italy, during the week of Sept. 18, 1922. At the first annual meeting, held last June in London, there were more than 200 American business men, representing virtually every industry in the United States, in attendance. The date set for the next meeting was decided upon at a recent meeting of the council of the International Chamber held in Paris.

35 Per Cent Gain in Asphaltic Pavement Yardage

Reports from city engineers to the Asphalt Association, New York, show that over 30,000,000 sq. yds., or 1,750 miles of asphaltic pavement, 30 ft. wide, will be laid on city streets this year. Reports from state highway departments indicate that 23,000,000 sq. yd. will be laid on the state highways while the area laid in counties and other districts will bring the total to 65,000,000 sq. yd., or 3,690 miles of asphalt pavements 30 ft. wide. This will be an increase of 35 per cent over the yardage in 1920.

Southern Power Co. To Build Two New Plants

The Southern Power Co., through the office of W. S. Lee, vice-president and chief engineer, has announced that it has just let contracts for the wheels and generators for the two new stations on the Catawba River.

The first of these is an addition to the present plant at Great Falls, S. C., and will be known as Great Falls Power House No. 2. The machinery contracts now let call for three units, each of 18,750 k.v.a. capacity. In the plant construction are involved 35,000 cu. yd. of concrete masonry and 100,000 cu. yd. of excavation. The dam at this point is already constructed, and the wheels will operate under a head of 72 ft.

The second new installation is to be made at a point 12 miles from Charlotte, N. C., and will be known as the Mountain Island Station. This will be an entirely new installation. The work required includes the building of a dam, penstocks, power house, etc. Four 18,750-k.v.a. units are to be installed. The construction work includes 220,000 cu. yd. of concrete masonry; 250,000 cu. yd. of rock excavation and 400,000 cu. yd. of earth fill. The head at this plant will be 80 ft.

The wheels and generators in the two plants will be of identical design. The wheel contract has been let to the S. Morgan Smith Co. and the generator contract to the Allis Chalmers Co. Contracts for the construction work are to be let shortly.

Jersey City Favors Municipally-Owned Gas Works

A majority of nearly 31,000 votes was cast in Jersey City on Nov. 8 in favor of acquiring or building gas works for light, heat and power for both public and private use. No plan of action has yet been adopted.

Bureau of Standards Studies Soil Corrosion on Iron and Steel Pipe

The Bureau of Standards has recently undertaken an extensive investigation of the corrosive action of soil on pipes used for gas and water mains and services. In this investigation the Bureau of Standards has the co-operation of the Bureau of Soils of the Department of Agriculture, pipe manufacturers and the public utilities. Forty locations have been selected as representative of the principal families of soils to be found throughout the United States and in them will be buried a number of samples of every kind of iron and steel pipe in commercial use.

Complete data on the physical and chemical properties of the soil will be obtained, also the chemical analyses of the pipe, their microstructure, and complete metallurgical heating will be determined. Extensive laboratory experiments will be conducted to determine the effects of variations in individual characteristics of both soils and pipe materials. Some tests of representative pipe coatings will also be undertaken.

It is expected that a good deal of data as to the relative rates of corrosion of different kinds of pipes in the soils under observation will be obtained within two or three years, but the experiment will probably continue over a period of eight or ten years. Progress reports will be published periodically.

Plan To Tap Lake 45 Feet Below Water Level

The Tule and Baxter Creek Irrigation Districts in northern California have contracted with Leon Bly for the construction of a complete irrigation system to provide 50,000 acre-ft. of water per annum, and to cost $1,250,000. The contractor is to turn the system over to the districts with water rights, rights-of-way, structures, etc., complete and ready for operation. The two districts involve a total of 25,000 acres in the Honey Lake basin and the water supply is to be taken from Eagle Lake.

The plan proposes a distribution system by means of an 8,000-ft. tunnel that will tap the lake 45 ft. below water level. There are approximately 1,000,000 acre-ft. in the lake above the proposed tunnel level. If the level is drawn down 45 ft. below the present height, the area of the lake surface would be reduced from 30,000 to 8,000 acres and the saving in evaporation on this 22,000 acres is expected to be enough to supply the annual requirements of the districts.

Features of the distribution system will be a 5,000-ft. flume to carry 250 sec.-ft., and several large siphons, one of which will be 52 in. in diameter and 16,000 ft. long. The area to be irrigated is largely sage-brush lands, most of which are now desert. The scheme for tapping Eagle Lake has long been under consideration; a tunnel was started in 1873 but never finished.

T. H. Means of the Cope, Rand, Means Co., San Francisco, is engineer for the irrigation districts.

California Objects to High Road Costs for Heavy Trucks

Pointing out that in the production of motor trucks in the United States in 1920 only 2 per cent were of 5-ton capacity and only 1 per cent over 5 tons, the California Highway Commission has issued the following statement, which raises the question of the advisability of adding greatly to road construction costs for the sake of a comparatively few users:

"As the ratio of use must be in close proportion to the ratio of production, it follows that only about 3 per cent of vehicles using California State highways are of the so-called heavy duty type. This year there were approximately 40,000 trucks of all kinds registered in the State, which indicates only about 1,200 to 1,500 trucks of 5-ton or more capacity.

"Highway construction, like other governmental activity, is based on public necessity, and this necessity should be met reasonably when highways are built, adequate to sustain 90 per cent of the traffic. In California this percentage will include all motor, and other vehicles, up to and including two ton capacity. Assuming that for $30,000 per mile an improved highway can be built adequate to sustain 90 per cent of the vehicular traffic of the State, but that it will require $50,000 per mile to construct a highway which will sustain the weight required by 10 per cent of heavier-duty trucks, should the general tax payer be required to invest an additional 66 per cent in road construction for the exclusive benefit of this particular class of heavy vehicles?

"In California highways are being constructed from bond funds provided by general taxation. Motor vehicle license fees are inadequate to provide funds necessary for proper maintenance, and the fees bear no relation to the wear and tear to which the vehicle licensed subjects the highway. The legal weight limit here is equaled by only three other states in the Union."

Ask Bids To Build Piers of Philadelphia Bridge

Bids to construct the two main piers of the Delaware River bridge to connect Philadelphia and Camden are asked by the Delaware River Bridge Commission, 806 Widener Bldg., Philadelphia, until 3 p.m., Dec. 19. The piers, located approximately at the pierhead lines, are to be sunk to bed rock by the pneumatic caisson process. They will be 70 x 143 ft. each.

Civil Service Examinations United States

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

One vacancy in each of these positions in the Bureau of standards, Department of Commerce, Washington.

Structural Engineer, $3,600 to $4,800 a year.

Associate Structural Engineer, $2,500 to $3,600 a year.

Assistant Structural Engineer, $1,800 to $2,400 a year.

Junior Structural Engineer, $1,200 to $1,500 a year.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Meeting, New York City, Nov. 8-19.

NATIONAL MUNICIPAL LEAGUE, New York City; Annual Meeting, Chicago, Nov. 16-18.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York City; Annual Meeting, New York City, Dec. 5-9.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; Annual Meeting, Omaha, Neb., Dec. 5-8.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

The Engineers Club of Seattle, (Wash.) has leased the College Club Building as its new headquarters.

The Houston (Tex.) Engineers' Club, on Nov. 1, was addressed by Dr. Edward Ardern of Manchester, England, on "Activated Sludge Process."

The Webster City Engineers' Club of Webster City, Iowa, Oct. 29, was addressed by E. E. Schenk, on "What the Club can do for the City," and by Prof. J. H. Dunlap on "Is the Present Engineering Education Adequate?" Mr. Schenk argued that the engineer should mold public opinion to the attainment of better public improvements. Following Prof. Dunlap's talk a committee on the education an engineer should receive was appointed to collaborate with active Iowa clubs and report to the Iowa Engineering Society in January at Sioux City.

The Princeton Engineering Association of New York, composed of technical graduates of Princeton University, has created "The Cyrus Fogg Brackett Lectureship in Applied Engineering Technology." The lectures will be given at Princeton and the speaker at the first meeting, Dec. 1, will be Samuel Insull, president of the Commonwealth Edison Co., Chicago, on the subject of "The Production and Distribution of Electric Energy in the Central Portions of the Mississippi Valley."

The Allied Engineering Association, Charleston, S. C., at its Oct. 17 meeting was addressed by Col. Eugene Kelly, manager of the White Truck Agency, Charlotte, on the motor truck, its uses, cost and maintenance, and also on good roads.

The Society of American Military Engineers, New York Post, at its meeting Nov. 1, in the Engineering Societies' Building, New York City, was addressed by Maj. George W. Johnson, of Columbia University, on "Strategy and Tactics of the Great War in Their Relation to Geographical and Geological Features of the Theatre of Operations." The talk was illustrated by lantern slides.

Engineering Institute of Canada—At a recent meeting of the civil engineers of London and St. Thomas, Can., preliminary plans were made for a formation of a branch of the Institute. Organization will take place Nov. 16. At the preliminary meeting, H. A. Brazier, city engineer of London, was elected chairman.

PERSONAL NOTES

HARRY L. MAIER, formerly engineer in charge of sewers, Street and Sewer Department, Wilmington, Del., has been appointed chief engineer, succeeding Edgar M. Hoopes.

JAMES W. PHILLIPS, chief of the grade-crossing division of the Bureau of Surveys, Philadelphia, has been engaged to represent the City of Minneapolis in a suit involving $12,000,000.

A. CRAINE, formerly division engineer of the Chicago, Burlington & Quincy R.R. St. Joseph, Mo., has been appointed district engineer, maintenance of way, with headquarters at St. Louis, Mo.

GEORGE POSEY, who recently has assisted in preliminary surveys of the Sacramento-Woodland railroad and in Richmond harbor developments, has been appointed surveyor of Alameda County, Cal.

DONALD E. A. CAMERON, formerly engineer with Robinette-Bruyere-Cameron, Toledo, Ohio, has been appointed chief engineer for the Watts & Suhrbier Co., general contractors Toledo, Ohio.

RICHARD A. HALE has been appointed chief engineer of the Essex Co., Lawrence, Mass., to fill the vacancy caused by the death of Hiram F. Mills. As resident engineer, Mr. Hale took charge of the Essex Co. work in 1892, when Mr. Mills went to Lowell. Later on, Mr. Hale was made principal assistant engineer. Although Mr. Mills held the title of chief engineer up to the time of his death he had not visited Lawrence nor taken any active part in the Essex Co. for the past ten years.

J. E. BARLOW, formerly city manager of Dayton, Ohio, has been appointed city manager of New London, Conn.

THE RANDOLPH-PERKINS Co., engineers and manager, successor to Isham Randolph & Co., the Edmund T. Perkins Engineering Co., and the George B. Massey Co., has incorporated with offices in Chicago. The officers of the company are LeRoy K. Sherman, president; George B. Massey, vice-president; Charles T. Mordock, treasurer; and Robert Isham Randolph, secretary. Mr. Sherman was formerly chief engineer and vice-president of the Edmund T. Perkins Engineering Co. Mr. Massey is a mechanical engineer specializing in excavating machinery and methods. Mr. Mordock was formerly Chicago representative of the J. G. White Co. and specializes in public utilities. Mr. Randolph was formerly senior partner of the Isham Randolph & Co., specializing in land drainage, levees and pumping plants.

THEODORE F. LEIST, formerly major of engineers, Construction Division, U. S. Army, and recently architect of the central district with the bureau of valuation, Interstate Commerce Commission, has been made Chicago representative of the National Lumber Manufacturers' Association.

OBITUARY

SAMUEL M. GRAY, consulting engineer, of Providence, R. I., died in Slocum, R. I., Nov. 5. A sketch of his professional experience, which included 31 years of practice, mainly in the fields of water-works and sewerage, will appear in next week's issue.

COL. GEORGE H. WEBB, chief engineer, Michigan Central R.R. since 1905, died Nov. 3 in Newton, Mass. He was born in Dubuque, Iowa, in 1860 and was graduated from the Pennsylvania Military College in 1880. His first position was that of rodman with the Baltimore & Ohio R.R.; later he was levelman and transitman with the Pittsburgh Southern Ry. and division engineer Pittsburgh & Western R.R. Leaving railroad work in 1883 he became city engineer of Johnstown, Pa. and in 1884 was made engineer in charge of construction work for the Johnson Steel Street Rail Co. Later he returned to railroad work as assistant engineer on branch lines of the Chicago, Burlington & Quincy R.R. and from 1889 to 1891 he was engaged in the construction of government railways in Chile, for two years of this time as division engineer of the North and South American Construction Co., in charge of all construction. He then became division engineer and superintendent of construction, Summit division, Central Ry. of Peru, through the main range of the Andes. From 1893 to 1897 he was engaged in private engineering practice, and then became chief engineer of the Cincinnati, Georgetown & Portsmouth Ry. His connection with the Michigan Central began in 1903, when he located the Ostimo division. During the war he was lieutenant-colonel of the 16th Engineers in France and later served as section engineer, intermediate section, (east) of the Division of Construction and Forestry of the A. E. F., at Nevers.

HOWARD C. HOLMES, civil and consulting engineer of San Francisco, died in that city on Oct. 30. He was born in Nantucket, Mass., in 1854. He went to San Francisco and started at an early age as a surveyor; when he was nineteen years old he made the topographical survey for the development of Lake Chabot. For some years he was assistant engineer of the California State Board of Harbor Commissioners and later chief engineer. Early in his career he gave attention to the construction of cable railways and was identified with both design and construction on a number of the San Francisco cable systems as well as similar lines in Seattle, Portland and Spokane. He had charge of the foundation work on the San Francisco Ferry Building and carried out the construction of the Alameda mole, the Key Route Mole, the greater part of the Oakland, Alameda and Piedmont Railroads, the yacht harbor and freight and passenger terminal at the 1915 Panama Pacific Exposition and the Hunter's Point drydocks. He was at different times the former consulting engineer of the Massachusetts Harbor and Land Commission, the Esquimalt Shipbuilding and Drydock Co. of British Columbia, the Port of Portland Dock Commission, the Bethlehem Shipbuilding Co., the Moore Shipbuilding Co., the Western Pacific R.R. and other corporations.

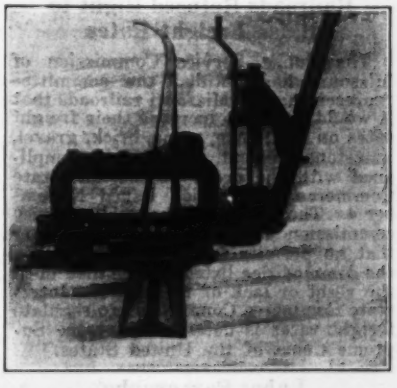
WILLIAM E. BAKER, civil engineer, died in New York City Nov. 7. He was born in Springfield, Mass., 1856, and was graduated from Lafayette College in 1877, of which institution he was a trustee for many years. From 1877 to 1888 he was engaged in railway work on the engineering staff of the St. Paul & Pacific R.R. as transitman and engineer; as transitman with the engineering staff on the survey of the Canadian Pacific Ry. through the Rocky Mountains; and as resident engineer in charge of bridges and buildings of the International & Great Northern Ry. From 1888 to 1892 he was with the Thompson Houston Electric Co. in charge of installation of electric equipment of the West End Street Ry., Boston, Mass. He was general manager of the Columbian Intramural Ry., at the World's Fair in Chicago and later general superintendent and general manager of the Metropolitan West Side Elevated R.R., Chicago.

MAJOR-GEN. PETER C. HAINS, U. S. A., retired, Civil War veteran, and former member of the Isthmian Canal Commission, died at Washington, D. C., Nov. 7. He was born in Philadelphia in 1840 and was graduated from the U. S. Military Academy at West Point in 1861. He was commissioned second lieutenant in the Second Artillery on June 24, 1861, and two years later was transferred to the Corps of Engineers, being promoted through the several grades until he became a brigadier-general in 1903. During the Civil War, he served in the defenses of Washington, in the Manassas campaign and was engaged in the battle of Bull Run. He was in the Virginia Peninsular, Maryland and Rappahannock campaigns, and was chief engineer of the Thirteenth Corps from March until July, 1863. In 1862 he was brevetted captain "for gallant and meritorious services" in the battle of Hanover Court House, Va.; major, in the same year, for services during the siege of Vicksburg, Miss.; and lieutenant-colonel, in 1865, for services during the war. He served also in the Spanish-American war as brigadier-general of volunteers and was in command of the Third Division, First Army Corps, and later was in command of the Second Brigade, First Division. He was a member of the Nicaragua Canal Commission in 1897 and 1898 and later served as a member of the Isthmian Commission. His army assignments included numerous works of harbor and river improvement and harbor defense. He retired from active service in the army in 1904. He was appointed major-general, U. S. A., in 1916, under a special act of Congress and was assigned to active duty in 1917 as engineer, Norfolk Harbor and River District. He retired from active service in 1918. Gen. Hains developed the concrete mixer which bears his name.

EQUIPMENT AND MATERIALS

Lever-Handled Hacksaw

A portable hacksaw for cutting rails and steel shapes, brought out by Crerar, Adams & Co., of Chicago, has the frame clamped to the rail or shape to ensure



a straight cut and the saw is operated by a long lever so that the work is faster and less laborious than operating a hand hacksaw. The frame is adjustable to any width up to 9 in. and to any horizontal angle up to 45 deg. Saws 14 to 17 in. long are used, and the machine in working order weighs about 110 lb. Track, bridge and building construction and track maintenance are the fields of work for the new hacksaw. It is stated that a 90-lb. rail can be cut in 30 minutes, a 125-lb. 9-in. grooved girder rail in 45 minutes, and a 9-in. I-beam in 25 minutes.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Railroads Show Operating Gain

The net operating income of 197 Class 1 railroads amounted to $82,707,607 for September, 1921, an increase of 11 per cent reported for September, 1920. This report lacked four roads to be complete. Road revenues for the month were $479,938,638, a decrease of 19.7 per cent compared with the amount a year ago. Operating expenses for the 197 roads were 26.2 per cent less this year than in September, 1920. Expenses this year stood at $865,342,237. In August the roads reported net railway operating income of $90,241,103.

The greatest single saving in expense was accomplished by the eastern district which cut its operating cost 29.8 per cent.

Railways Placing Orders For New Equipment

The Chicago, Burlington & Quincy R.R. and the Colorado & Southern Ry. Co. have been authorized to purchase $15,000,000 worth of new rolling stock, and it is understood that immediate arrangement is to be made for the purchase of 7,300 freight cars, 55 heavy freight and passenger locomotives and 127 all steel passenger cars. This decision was made on the "belief that there is a decided upward tendency in traffic and that before long additional facilities will be required to meet the transportation demands of the country."

A report has been made also that the Illinois Central R.R. Co. has placed orders for 900 cars, at an aggregate cost of $2,660,000 and has invited bids for 2,000 coal cars to cost $4,000,000.

Railroads Refused Right to Raise Freight Rates

The Public Service Commission of Missouri has notified the committee representing the Missouri railroads that it would refuse to increase their freight rates on coal, coke, stone, brick, gravel, limestone, cement, oil, etc., in compliance with the order of the Interstate Commerce Commission issued November 4. The refusal of the public service commission is construed as meaning that no permits for higher rates upon the commodities listed will be filed until the right or lack of right of the Interstate Commerce Commission to regulate freight rates is determined by the Supreme Court of the United States.

Labor Paragraphs

The 79 member firms of the Employers' Association of Detroit added 4,400 workers to their pay-rolls, making the total at work 115,800, although half are on part time schedules.

Sacramento is in urgent need of building labor of all classes. Lowered material prices are reported to have increased construction.

Bricklayers now place 1,300 brick per day as against 600 to 700 in war days, according to W. L. Rathmann, president of the St. Louis Chapter of the American Institute of Architects.

Trend of Business

Stock Market—Better tone resulting from good news from iron and steel industry, improved demand for copper, good railroad reports, and the upward trend of the bond market. Total sales last week were 2,484,337, as against 6,641,461 a year ago; high average of fifty stocks was about 67 as compared with nearly 80 in the same week last year.

Bonds—Slight check on buying, probably due to unloading by those who bought at low prices eight or ten months ago. New issues were heavy for a three-day week, totaling $55,000,000. Two industrial issues—Goodyear Tire & Rubber Co. 8 per cent sinking fund debentures, due 1931, at 99½, and Wilson & Co. ten-year 7½ per cent convertible debentures, at 96½—amounted to $37,725,000. Municipals strong throughout the week.

Money—No stringency, and easy money expected to the end of the year. Following is range of ruling call money loans last week and for the same period in other years: 5½ per cent; 9 per cent in 1920; 8 in 1919; 6 in 1918; 4 in 1917; 2½ in 1916; 1½ in 1915, 5½ in 1914. Total exchanges of checks last week (two holidays) in New York, as reported by the Clearing House was $2,840,410,705 compared with $4,665,924,290 the preceding week.

Foreign Exchange—German marks dipped to .33 cent. Other markets generally inactive.

Textiles—Census Bureau reports that cotton actually ginned prior to Nov. 1 amounted to 6,646,136 bales against the Department of Agriculture's forecast in October of 6,537,000 as the total yield. A net 1921 crop of 7,500,000 bales is predicted. The contract cotton market has dropped $9 as a result of the Census report; spot down $6. Thus, with ample supply, prices are not expected to go higher.

October Steel Production was one-third greater than for September. October steel ingot production was at the rate of 23,000,000 gross tons per year, or 44 per cent of estimated capacity. The Corporation's unfilled tonnage decreased 273,841 tons last month. Steel prices are slightly weaker than last week.

Chicago Committee Proposes to Enforce Landis Award

A committee of citizens of Chicago has been formed to bring about a full adoption and enforcement of the terms and conditions laid down two months ago by Judge Landis in the building arbitration decision.

The reasons for the establishment of the committee were summed up by J. W. O'Leary at the organization meeting: "In spite of his efforts and the agreements of contractors and building trade unions to participate in the arbitration some contractors and unions have proceeded with work in Chicago without regard to the award. . . . The committee is making no fight on trade unions as such. Those unions which, in letter and in spirit, have accepted the Landis award and are working under it, will have the support of the committee in their action. Those crafts which withdraw from the award or refuse to accept its conditions automatically place themselves beyond the support of the public. Those contractors who have entered into agreements with unions outside of the award deserve neither the consideration nor the support of the public."

More than 150 citizens have already enrolled and all the money necessary to carry on the work is said to be available. Addresses have been made by leaders of a similar movement in San Francisco where it is said $1,000,000 was available in a similar campaign to clear up the restrictions on the building industry.

New Roads for New Jersey to Cost $1,885,741

Road building contracts aggregating $1,885,741 will be awarded by the New Jersey State Highway Commission as a result of President Harding's conference on unemployment giving $942,870 in federal aid to New Jersey. The national appropriation was voted with the understanding that New Jersey would match whatever appropriation was forthcoming. New Jersey's allotment comes out of the $75,000,000 available for road work. Governor Edwards wired the Government that "New Jersey will immediately prepare to contract for new roads as a result of this action."

Building Trades Employers Make Survey of New York City

A complete survey of conditions in the building industry in New York City is being undertaken by the Building Trades Employers' Association upon which the 1922 wage agreement between employers and employees will be predicated. The survey will reveal exactly what is to be expected in the volume of construction needed and likely to be contracted for under a given set of conditions. It is also hoped that information will be secured which will indicate the attitude towards construction of building and loan associations, banks

and other financial institutions having money to loan for construction purposes.

The employers association feels that labor and materials are not alone responsible for the holding up of work, and cites several examples in support of such a contention. It points to Philadelphia, for instance, that despite a 23 per cent reduction in wages, still lacks construction of any magnitude.

similar reduction is to be sought. It is not known exactly what the reduction will be but it is believed it will approximate 10 per cent for all operatives in the eastern and western districts. The wage reduction will affect approximately 1,650,000 railroad workers of all classes.

It is understood, however, that the new wage reduction, if granted by the Railroad Labor Board, will be transrates are considered, it is possible that the consideration of the proposed wage reduction will not be arrived at by the Railroad Labor Board before three or four months. However, it is believed in railroad circles that the Railroad Labor Board will not long hold off consideration of the proposed reduction if an immediate translation of that reduction into lower railroad rates is quite possible of realization.

Do You Know the Business Side of Construction?

THE KIND of business information published weekly by *Engineering News-Record* needs to be read by all engineers, contractors and materials producers and dealers who hope to keep up with the business of their profession and industry. *Engineering News-Record* keenly recognizes the need for economizing readers' time. Expert, inside knowledge of finance and trade can come only with deep and continual study of the multifarious elements that make up modern business. Financial leaders employ such students of business to keep them and their executives informed of the movements in industry and the meanings of the movements. *Engineering News-Record* gives a rapid survey of business in general and of construction affairs in particular.

A general knowledge of the trend of business, as referred to the construction industry, is essential to the successful conduct of engineering and contracting enterprises. Such knowledge goes a long way toward assuring the success of both the organization and the individual. It is this knowledge that *Engineering News-Record* is offering each week in its BUSINESS SIDE OF CONSTRUCTION.

The Regular Features of This Department Consist of the Following:

MONTHLY PRICES OF CONSTRUCTION MATERIALS. — *Including "Ups and Downs of the Market."*

LABOR RATES AND CONDITIONS THROUGHOUT THE COUNTRY. — *Covering seven classes of labor in twenty cities.*

ENGINEERING NEWS-RECORD CONSTRUCTION COST INDEX NUMBER.—*Giving comparison of current cost with cost in 1913.*

ENGINEERING NEWS-RECORD CONSTRUCTION VOLUME INDEX NUMBER.—*Giving amount of contracts let per month and per year in terms of 1913 values.*

CONTRACTS AWARDED EACH MONTH. —*Value of contracts let in each class of construction.*

TREND OF BUSINESS.—*Highlights in finance and human relations—stock, bond and money markets, wholesale and retail prices, cost of living.*

SKETCH OF PUBLIC BOND SALES EACH MONTH. — *Presenting essential data on some thirty representative issues of state, county and municipal bonds.*

MATERIAL STOCKS AND PRODUCTION. —*Showing time required to get materials on the job in the important cities.*

IN ADDITION to these standing features there is a stream of special studies, which completes the picture of construction activity. Just a few of these since March this year:

SPRING PRICES OF CONSTRUCTION MATERIALS SINCE 1913.—*Giving prices of all the important materials for April, May and June of each year since 1913, and an interpretation.*

CEMENT AND STRUCTURAL SHAPES COMPARED FOR 21 YEARS.—*With charts and a table of annual production.*

CEMENT, LUMBER AND STEEL BEFORE AND SINCE THE WAR. — *Prices over nine to twelve years, with charts. Comparison of prices with production.*

WHOLESALE COSTS — CONSTRUCTION AND LIVING. — *General construction costs compared wtih wholesale prices of all commodities and with special groups of commodities.*

FREIGHT RATES ON PRINCIPAL BUILDING MATERIALS. — *Showing actual shipping cost to contractor.*

WAGES AND THE COST OF LIVING.— *Relation between wholesale and retail prices shown. Actual decline in living cost established.*

CONSTRUCTION NEWS hardly needs an introduction to readers of *Engineering News-Record.* This is the department where jobs are found —jobs for the contractor's organization and for the individual. In 1920 a total of 26,986 items were published, of which 11,709 called attention to proposed work, 6,028 announced bids desired, and 9,249 contracts let. Every one of these items was sent in by our regular correspondents. Construction News is 100 per cent verified.

All this is the business side of construction as conceived and carried out week by week by *Engineering News-Record.* Modern business is complex. It is not enough to know only the little world of one's own organization. The cement man must know about brick and hollow tile, the brick man must know about cement and tile, the steel man about lumber, and all must follow the broad trends of the construction industry. The contractor must know the prices and availability of materials and labor, where to obtain jobs, and at what rate he can borrow money. The engineer must know the prices and availability of materials and labor, where to obtain jobs, and at what rate he can borrow money. These, and more, are the BUSINESS SIDE OF CONSTRUCTION.

Railroads to Push Plan To Secure New Wage Reduction

Following an announcement made by managers of a western group of railroads at a meeting held in Chicago November 7 that immediate posting of notices of wage reductions of 10 per cent would be made, executives of the railroads in the classification territory east of the Mississippi and north of the Ohio River have announced that a

lated immediately into reduced railroad rates, with the agreement of the Interstate Commerce Commission. Executives have been in conference with the Interstate Commerce Commission in order that a full and final understanding of the situation may be made clear.

Inasmuch as the Railroad Labor Board has made known that it plans to clear up its docket insofar as questions concerned with wages and working conditions are concerned before new wage

Heavy Freight on Lumber Injures the Industry

"As long as it costs more to transport lumber from the sawmill to the consumer than it costs to make the lumber in the first place, conditions in the lumber industry will never be satisfactory," said a prominent lumberman in Washington a few days ago. He cited the instance of a car load of 2 x 4's sent from Tacoma to Buffalo, the freight

bill amounting to just one and a half times as much as the lumber cost at the mill. Another lumberman in the South told of having shipped a carload of dressed lumber to Cleveland and after he had paid the freight his net profit from the transaction amounted to $6.75.

At one end of the scale are those who want lumber and are eager to build. At the other end are the sawmills with abundant supplies of lumber. Between are the railroads.

These are not isolated instances, nor are they confined to the lumber industry. They are typical.

Will Publish E. N. R. Cost Number 1913 to Date

So many requests have been received for a full list of *Engineering News-Record's* Construction Cost Index Number that this is being compiled for every month from 1913 to date. The numbers will be published as fast as computed, the first installment (January, 1920, to date) appearing Nov. 24. The other installments—each with a chart to date—will follow each week thereafter. Get the complete list.

Dallas Co. to Let Contracts for 67 Miles of Roads

The Dallas County (Tex.) Commissioner's Court expects to let contracts for 67 miles of improved roads on Dec. 12, as a result of the sale of the second series of District 1 road bonds, aggregating $2,700,000. The price received for the bonds is equivalent to 96.75 and the purchasers pay par and accrued interest making a total of $2,786,625. The county pays a brokerage fee of $87,750. The sale nets the road district $2,698,875 or within $1,125 of the face value of the bonds. The bonds bear 5½ per cent interest.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 3, the next, on December 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.88	$4.00	$4.00	$2.88	–$3.06	$3.75	$3.70	$4.00	$4.00
Structural rivets, 100 lb	3.70	5.25	5.50	—3.43	4.15	4.25	5.50	4.50	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.78	3.20	3.50	—2.68	—3.08½	3.57½	2.90	3.75	3.25
Steel pipe, black, 3½ to 6 in. lap, discount	51%	52.65–5%	45%	+57%	58.9–5%	38%	51.8%	50%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	40.50	54.30	42.60@44.10	47.80	52.00	50.00	53.00	60.00
Concreting Material:									
Cement without bags, bbl	2.40	2.60	2.55	1.97	2.26	3.10	2.84	3.10	3.12
Gravel, ¾ in., cu.yd	1.75	2.00	2.25	1.65	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.25	1.35	2.25	1.65	.50	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.80 to 1.90	2.25	3.20	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	45.00	38.00	37.00	48.00	–35.00	50.00	–30.00	24.00	120.00
Lime, finishing, hydrated, ton	16.99	19.00	25.00	18.00	29.00	30.00	22.00	27.50	21.00
Lime common, lump, per bbl	3.69	1.60	2.75	1.40	1.40	2.95	1.90	2.75	15.00
Common brick, delivered, 1,000	18.40	—10.50	12.72	11.00	17.00	14.00	18.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.10	.124	.0821	.092	.09	.12½	.10	.08@.29
Hollow partition tile 4x12x12, block	.11120	.10	.124	.0657	....	.10	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.72	.85	.93	.74	.80	.90	.83	.79	.85
Common Labor:									
Common labor, union, hour	.75@.80	.35	.....	.72½	.50	.50@.55	.75	.50@.60	....
Common labor, non-union, hour	.....	.20	.35@.45	.35@.40	.50	.35@.40	.50@.55	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Seattle** quotes on Douglas fir instead of pine; and on lime in paper bags. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.2 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Quotations on structural steel shapes, plates and bars at the Pittsburgh mills remain $1.50@$1.65 per 100 lb. Bars are easily obtainable at $1.50; $1.60 is the minimum on shapes and plates, with small tonnage selling at $1.65. Mill shipments, New York, of shapes and plates continue at $1.88@$2.03; bars $1.80@$1.88 per 100 lb.

The only actual increase in price in any of the construction materials quoted in the nine cities listed, is a reduction in steel pipe discounts in Chicago. Wrought pipe is the first steel product expected to show any marked improvement in the construction market. Montreal quotes 3½-in. lap-welded, black steel pipe at $35.10, galvanized $44.46 and 3½-in. black wrought-iron pipe at $47.97; galvanized, $57.33 per 100 ft.

Structural shapes are quoted in Minneapolis at $3.06 as against $3.16 per 100 lb. Chicago quotes structural rivets at $3.43 as compared with $3.68 formerly. Both Minneapolis and Chicago report reductions in reinforcing bars.

A reduction of $1 per M. ft. is quoted on Douglas fir in Minneapolis and on long-leaf yellow pine, base sizes, in San Francisco. Seattle quotes Douglas fir, 2-in. tongue-and-groove, 10 in. x 16 ft. at $17 as against $24 per M. ft. Lumber prices with a few exceptions show a tendency to stiffen with increased demand, especially as affecting the export trade.

Common brick is quoted in Atlanta at $10.50 as against $11 per 1,000; no changes in any of the other principal cities.

Linseed oil quotations have remained stable throughout the country during the last week.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

H. J. MEHREN, Editor

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First General Rate Reduction

IT WAS a good move on the part of the railways to reduce rates 10 per cent on agricultural products in advance of action on further proposed wage reductions which, they promise, are to be passed on to the public if granted. It indicates a willingness to add to the stress under which they are working and to suffer some decrease in the rising rate of their earnings. This attitude will bring public appreciation, even if it will not—and it should not—decrease the public's demand for lower rates. Rate deflation is as necessary as deflation of other charges upon the public. That wages need deflation simultaneously is not to be doubted, but a general rate reduction running ahead of wage lowering will tend to accelerate the latter.

Leadership in Industry

LAST week's paving-brick conference in Washington illustrates the helpfulness of the leadership in industry being afforded by the Department of Commerce. Secretary Hoover's well-known sympathy with the idea of eliminating all forms of industrial waste and the emphasis he has placed on the desirability of eliminating indefensible varieties makes it logical for industries that are burdened with an abnormal number of styles to appeal to the department for assistance. The fabricated products department of the U. S. Chamber of Commerce is working to the same ends and is furnishing the stimulus that is leading some industries to the department. In one way the department had very little to do with the result achieved last week; it took no part in the meeting other than to stress the desirability, as a general principle, of eliminating industrial waste; it offered no survey or report on the subject; it had no experts to counsel what, in detail, should be done. In another way, it had all to do with the good result, for without its encouragement the meeting might not have been held. It was entirely impartial. It had neither manufacturing ends to serve nor engineering theories to exploit or censerve. Its attitude in that conference should be an encouragement to other industries which need variety elimination.

Achievement in Detail

PROGRESS in any art finds reflection in the perfection and power of its detail devices. In the light of this principle the Stock Exchange Extension framing described in this issue by one of its designers takes high rank as a demonstration of how far the art of applying rolled steel to structural uses has progressed. The architect put unusually severe demands on the structural engineer by suppressing an entire story of interior supports and asking him to carry more than twenty stories over a large hall. The conditions imposed by this demand not only necessitated the remarkably heavy truss construction shown, but also restricted the wind bracing seriously. In respect to both of these difficulties the key to success lay in efficient, ingenious detail design rather than in new method or conception. Thus, the transfer of huge forces through the trusses was accomplished within surprisingly confined space limits by extreme concentration of metal in main members and by integration of multiple gusset plates with the truss members to such degree that the end diagonals are nothing more than splices connecting the gussets. Similar difficulties, though they are less obvious, were overcome in the wind-girder system, again through command of detail. The merit of the result achieved is easily overlooked, since the finished construction proves the possibility rather than the near impossibility of meeting the requirements imposed. Yet those who have themselves handled difficult cases of steel detailing will appreciate the problems involved and the relation of detail perfection to their solution.

Approaching Great Problems

BURIED in the daily routine of professional tasks amenable to precedent, rule, and weighing of dollar against dollar, the engineer tends to lose his appreciation of the creative thinking on which enduring achievement in the art depends. Indeed, the conceptions and intuitions of which it is composed are in a field somewhat remote and separate from the ordinary currents of professional thought, and are easily forgotten in the constant use of the tools that serve our work-a-day purposes. The thoughtful essay of Gustav Lindenthal on long-span bridge design, page 861 brings back to the consciousness the transcendent importance of broad contemplation and integral grasp of a problem. His stressing of the architectural viewpoint strikes near the root of the matter—not, we take it, because ornament or curved beauty-lines are of any significance, but because the structure that shall fulfill all its purposes most fittingly must be seen by the mind as an entity and must be evolved in complete harmony of its several elements; it cannot be pieced together of separately devised parts. In broad, truly creative consideration, the form and functioning of each element develops in subordination to form and functioning of the whole. It is in the great problems that this method of approach is indispensable—in those problems which, regardless of mere bulk, strain to the limit the capacity of materials or method. But its power and inspiration have value even in everyday work, in degree depending on the individuality of the engineer. If, then, the essay shall strengthen the engineer's regard for broad contemplation of his problems, it will contribute measurably to the advancement of the profession.

Solidity and Success

PRESIDENT HIBBEN, in opening the new term at Princeton University last month, pleaded with the students for "a revival of learning." In thorough intellectual discipline he saw aids in the settlement of

the difficult problems that have followed the wake of the war. It is not uncommon to hear emphasis laid upon the need for thorough scholarship as opposed to the veneer which is all that many men acquire in college. It is true that energy counts heavily in getting things done and rising to high place. But it is a mistake to think that typical American "pep" and selling ability are alone sufficient to carry men to high achievement. These things are valuable, but they are most valuable when they are the assets of a man with a well-disciplined mind.

Is the St. Lawrence Waterway Practicable?

NEW YORK—both city and state—is beginning to take notice of the St. Lawrence waterway project. The governor is making stump speeches against it, the metropolitan newspapers are viewing it with alarm and the Port Authority is calling for a counter-offensive against the propaganda of the Northwestern States association which favors the project. This is a good thing. The country needs waking up as to the magnitude of the proposition and its national importance. A good fight will serve to clear up misapprehensions and to decide the issue in the clear light of facts rather than on the basis of sectional preference and interest.

Much loose talk has been indulged in by both sides. New York, through its governor, has centered its opposition on the claims that the navigation advantages of the St. Lawrence can be more cheaply and safely served by the Barge Canal and that the power prospects are merely a scheme of the "interests" to get free power and charge excessive rates. The first claim has been answered epigrammatically by Governor Allen, of Kansas—"We are bound for Liverpool, not Buffalo." In other words, the transshipment charges at Buffalo and New York City which served so admirably to swing those two communities into a majority for the Barge Canal in 1901 are a horse of another color when viewed as added costs to the shipper. As to the "power grab," can any one take it seriously in these days of public rate control? The West, on the other hand, seeking a cheaper outlet for its grain, looks at the difficulties of navigation, the cost of the improvement, and the prospects for freight movement other than grain through the rosiest of glasses.

Out of the welter of biased argument three questions emerge—Is the project physically possible? Will it pay? How is it to be built, controlled and paid for? They may be answered by the forthcoming report of the International Commission. Meanwhile, what do we know about them?

Engineers have no doubt as to the feasibility of the waterway. To build a 25- or 30-ft. channel from Montreal to the Lakes and simultaneously to provide millions of horsepower is quite possible. Already one general plan has been submitted by international government engineers and several other schemes are before the Commission. Furthermore, it will be quite practicable to build an 8,000-ton ocean-going steamship which can be operated economically through the Great Lakes and on the St Lawrence—not as economically as a present lake steamer, but that is beside the question for there is to be no competition between the lake steamer plying only between lake ports and an ocean steamer tying up lake and ocean. Engineering details of the waterway will have to be worked out, but that is merely a question of time and talent.

As to the economics of the project, it should not be necessary to remind men with any regard for honesty in figures that the costs of the navigation features must be separated from those of the power-development, and that against each must be set separately the corresponding uses and benefits. To say that the power rates will pay a satisfactory return on the cost of the whole project is to ignore the practice of public regulatory bodies in basing returns on the cost of service. No commission will permit electric-rate earnings on the whole cost when a large part of the expenditure has been incurred by navigation features. The best that can be hoped for is that there will be a fair spread between the return allowed through the power charges and the rate at which the government can borrow money to finance the project.

If it be true that the proponents must be mindful in the use of figures equally true is it that the opponents must be honest and not set the whole cost of the project against the navigation benefits.

Whether the project from the navigation side is economically feasible remains to be seen. Estimated first costs now being used by the proponents are undoubtedly too low and the estimated freight flow a matter of guesswork. Bulk shipments—grain, coal, ore, raw chemicals—will be moved more cheaply, not only where no transshipment is required but also, on account of the perfection in bulk transfer, to and from inland locations where part rail haul is necessary. Bulk shipments, however, are only a part of the necessary business a lake to ocean waterway must do and the economies of package freight have not been thoroughly examined. Obviously shoes made at Brockton could be hauled by motor to Boston, loaded on a ship which would deliver them to a pier warehouse at Duluth cheaper than they could be by rail, but equally obviously a machine made at Pittsburgh could not be shipped to New York, sent by steamer to Cleveland and by rail thence to Louisville cheaper than over an all-rail route. Somewhere between these two examples are the economic limits of the waterway. Similar reasoning applies to the area of economic delivery beyond lake ports for goods arriving from Europe via the St. Lawrence.

As to power economies, there should be no question. The greatest water power in the world is going to waste on the St. Lawrence. It must and will be developed. The present issue is whether that power is to be developed by itself or whether the works necessary to create it shall be utilized to help create a navigable channel. Any investigation of the economies of the waterway as a freight carrier must be based on the cost which the navigation features add to the power project.

The last question to be answered is largely in the hands of the diplomats. How are we going about building an international improvement, which may prove directly profitable—that is in actual cash return—and guarantee equal rights, privileges and control. Will we form a corporation, with stock jointly held by the two countries, and issue bonds to pay for the improvement or will we form a joint commission and leave each country to appropriate the necessary money, to be raised of course by taxes equably distributed over the whole people? These are important details that have never been discussed by either country officially. The International Joint Commission will have to give some attention to them before individuals can consider them. As to selfish national interests there need be no question.

There are opponents and proponents on both sides of the line. And in the incredible event of war, no advantages are offered either nation; the military authorities are agreed on that.

What then does the St. Lawrence case boil down to? That there is a decidedly predisposing argument in favor of the project, but that much remains to be investigated by expert authority. That the West overemphasizes benefits and underestimates difficulties. That the opposition of New York is largely selfish, one more indication of the strange fear that apparently hangs over the state and city of being dispossessed of its premier position. How curious that a state could cheerfully gamble away $101,000,000 (which has grown to half as much again) on a doubtful canal project and then oppose the expenditure of two or three times that much by the whole country on a scheme which insures from the power revenue at least a return on more than half the investment—a business proposition so superior to that of the Barge Canal that no comparison is possible. Widespread discussion is going to be the best possible thing for the project, but even that discussion will not begin to tell until the International Joint Commission puts before both countries the data which have resulted from its two-year investigation.

Fewer Sizes of Paving Brick

AN AUSPICIOUS start was made last week in the elimination of indefensible designs in products manufactured for the construction field when a conference of engineers and manufacturers approved the reduction in current varieties of paving brick from 66 to 11. Work of this sort was undertaken during the war, and is now being resumed.

The recommendations in the paving-brick case, if approved by the organization represented, should bring to the construction field the benefits commonly conceded to flow from concentration on a limited number of models or varieties. Lost time in changing machines will be reduced, production will be increased, and overhead spread over a greater number of units. Less capital will be tied up in patterns, dies and special machinery. Carrying charges on stock will be reduced. These benefits, primarily, accrue to the manufacturer. In a competitive market they pass to the consumer.

We do not infer that reductions in paving-brick prices can be looked for at once, or even soon, but the healthier industry that will result must eventually show its effect in better service, a better product or lower prices.

The effort at Washington is to be particularly commended because the benefits will be secured without any sacrifice in quality, desirability or service of the product. For the manufacturer the elimination of 55 varieties from the current list is a radical improvement. Technically, however, the step is not radical. The varieties eliminated have no superiority over the varieties retained. To put it more broadly, the results sought by the paving and highway engineer can be obtained without loss by using the varieties retained.

In reaching its decisions the conference sought to balance manufacturing against engineering considerations. For manufacturing reasons a still smaller number of accepted varieties is desirable, yet engineering practice dictated retaining eleven. With these varieties the engineer has a choice of 3, 3½- or 4-in. pavements, which covers all the demands of present paving practice.

It should be remembered, too, that determinations of this sort are not made for all time. If future conditions should demand new sizes last week's recommendations will need revision, and this is provided for by the designation of a permanent committee composed of representatives of interested organizations. Moreover, there is nothing to prevent any engineer from getting anything he wants, provided he is willing to pay a premium in proportion to the added cost. In the past, the extra cost of freak sizes was loaded on to buyers generally. Now it will properly be assessed against those who insist upon departing from standard. This will create some dissatisfaction, yet we acquiesce in this trade practice in many other trade lines. In fact, the practice is well-nigh universal. If we choose a "special" I-beam for a steel structure, we expect to pay an additional price for it.

Last week's step, however, does not complete the work. It must be approved by all the organizations represented at the meeting. This approval should be prompt and hearty. The proposed simplification is in the interest of all concerned.

Wire Cable Questions

WHAT Mr. Lindenthal says of suspension bridge towers is likely to stir up various reflections, from those which revolve about the properly stigmatized "bandy-legged towers" of the Williamsburgh Bridge (and they are now proposing to call it the Roosevelt Bridge!) to those which doubt the possibility of dogmatizing on principles of steel designing. We are still fairly far back in the stone age as regards notions of architectural aesthetics, and men will disagree on questions of the beauty of steel towers. Everyone, no doubt, wishes to see stress carried visibly in naturally spreading paths from load to base; but, though we all think we know how this is to be accomplished in stone, in cast iron or in concrete, the strength of these materials is patently foreign to that of steel, and forms must therefore differ. We can afford to wait for fuller development of ideas on this subject.

On the other hand, the subject of cable strength is of immediate urgency, since it concerns the most efficient structural element we possess, and affects the possibility of many river crossings, quite aside from the fact that, if the wire cable is ruled out of the long-span field, one of our most highly admired bridge forms must be modified. Mr. Lindenthal casts doubt on the sufficiency of parallel-wire construction, as heretofore practiced, for extremely large cables. His reasoning is so weighty as to suggest that the bridge-building profession is under obligation to bring to light all facts discoverable as to the production, the stress behavior and the permanence of existing large bridge cables. That has not yet been done, but should be done in the future. Beyond this we have the possibilities of stranded cables, of eyebar chains and of built plate chains to consider—a large field for exploration in the fuller exploitation of the suspension bridge.

At the moment the subject is in highly activated condition, since the engineers of the Delaware River bridge have built up their project on parallel-wire cables of unprecedented size—and difficulty, says Mr. Lindenthal—while he himself is planning to use eyebar chains of enormous proportions for his great Hudson River crossing.

Heavy Steelwork in New York Stock Exchange Extension

Four Trusses Weighing 150 Tons Each Required To Span New Board Room and Carry 24-Story Building—Steel for Upper Stories Used in Erection Falsework

By John W. Pickworth
Member of the firm of S. C. Weiskopf, Consulting Engineers, New York

OF THE MANY unusual engineering problems in building construction presented by a crowded business district, the addition to the New York Stock Exchange, now in course of erection, contains some of the most interesting and unique. The present building, an 8-story structure situated between Broad and New Sts., is to be extended northward to Wall St. The addition is to be 24 stories high, faced with marble, and will be one of the most imposing buildings in the financial district. One of the top stories will be the home of a brokers' club, and the rest of the upper floors will be used as offices. The trading room or "board room," occupying the ground floor of the present building, is to be enlarged to include almost the whole area of the addition, three openings being cut in the wall between the two buildings for communication. The necessity of providing for this extension of the board room gave rise to the most interesting feature of the structural design, a group of exceptionally heavy trusses which carry the entire weight of the central portion of the building above ground. So far as the writer knows, these are the heaviest trusses ever used in office-building construction, and the columns supporting them are probably among the heaviest building columns ever designed.

Truss System of Support.—It was the architect's desire to make the extension of the board room an open space without columns, with a ceiling height of about 40 ft. Because of the importance of the lower floors, the trusses for carrying the structure over the board room had to be placed in the fifth story. These trusses, four in number, run north and south from columns on the Wall St. front of the addition to new columns just north of the old building. The third floor, forming the ceiling of the board-room extension, and the fourth floor, which forms a mezzanine in the third story, are hung from these trusses. The fifth and sixth floors frame into the bottom and top chords of the trusses respectively, the rest of the building standing on top of them.

As the plot is irregular the trusses vary in length, from 60 ft. 9¼ in. to 77 ft. 10⅛ in. c. to c. of supporting columns. Truss *C*, though not the longest, is the heaviest of the trusses, because the peculiarities of the various leaseholds which go to make up the plot necessitated designing that particular truss strong enough to carry a partition wall, should the owners desire to divide the building into two parts at the expiration of leases eighty-odd years hence. It weighs 165 tons, while the other three weigh about 150 tons each. Access to the different parts of the fifth story is obtained by doors or passages which go through the trusses between the diagonal members.

The depth of the trusses is 15 ft. 10 in. c. to c. of

FIG. 1. HEAVY TRUSS CARRYING 21 STORIES OF STOCK EXCHANGE EXTENSION
Triple gusset of end joint at right; part of forked hanger at middle of truss at extreme left.

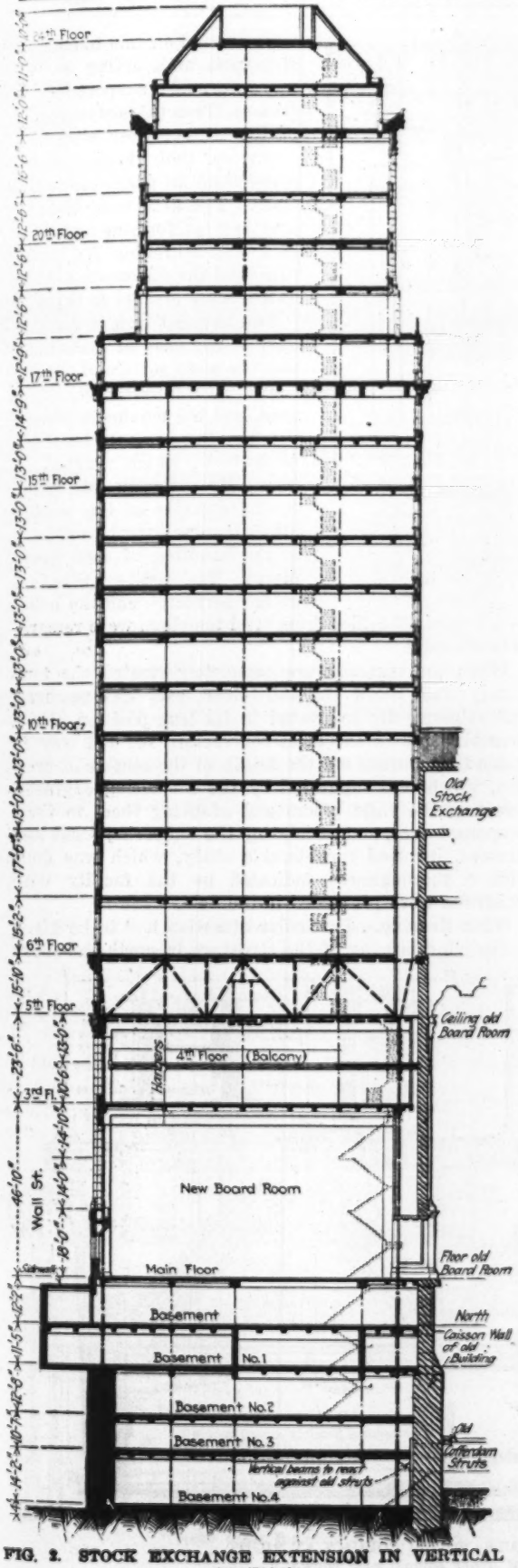


FIG. 2. STOCK EXCHANGE EXTENSION IN VERTICAL SECTION

chords. The calculated stresses run as high as 2,310 tons in the chords, while the heaviest diagonal has a stress of 2,480 tons. Column 13 receives the largest truss reaction, namely 2,406 tons, and the heaviest column load at the base is 2,556 tons. These large forces made necessary the design of particularly heavy built up sections for the columns and main truss members.

Truss Makeup and Joint Details.—There are many things that contribute to the engineering difficulties in a design of this kind. It was necessary to contend with the fact that the plot is of irregular shape, and further, is cut into several still more irregular pieces by property lines. Though having no relation to the design of the building as a whole, these lines had to be observed in order that legal difficulties might not arise due to encroachments and mutual dependencies, if the various owners should desire to separate when their present long leases expire. Then too, there is the great value of space in the financial district to be thought of. The structural work is continually being cramped to preserve architectural conditions, as a few more inches of headroom here, or a few more square feet of floor space there, are likely to be thought more desirable than the saving of steel through more economical design. Thus it was as the result of considerable study that the very compact riveted section used for the trusses and heavy columns, which made possible the design of a structure that would perform its functions within such dimensional limits, was developed. The problem of providing the heavy gusset-plate connections between the main members was a critical element in the design and the use of triple-thickness overlapping gusset plates interleaved with the plates of the columns and the truss chords furnished the solution, giving adequate strength of connection in the confined space available.

The columns and the main truss members are similar in design. In Fig. 4 is given a typical section of one of the members. The material is built up on a 14-in. 287½-lb. Bethlehem H-section, forming the web of the member, with three 24 x ¾-in. plates on each side, and angles and fillers as shown. This design lends itself to the use of the heavy gusset plates needed, which consist of one, two, or three thicknesses of ¾-in. plate replacing the 24-in. side plates of the members. They are stepped off, and compensating material is provided over the splicing points to preserve the required section throughout.

In order to carry the interior columns above without splicing to the trusses, which would have been complicated and taken up valuable floor space, the gusset plates at the truss panel points were extended slightly above the top-chord material and milled to form an accurate bearing. The milled ends of the columns above are seated directly on these milled bases, and angle clips or small plates are used to hold the columns in place. Wing plates on the column are used to develop the required bearing. The heaviest of these columns brings in a calculated concentration of 1,086 tons.

The size of the supporting columns, and more especially the spread of their foundations, made it necessary to keep them some distance back from the property lines, while the columns above the trusses are required to be nearer the building face. For this reason the end posts of the trusses are inclined outward, the end panels of the trusses thus forming cantilever extensions on which the wall columns above are supported.

The middle hanger for the third floor intersects the

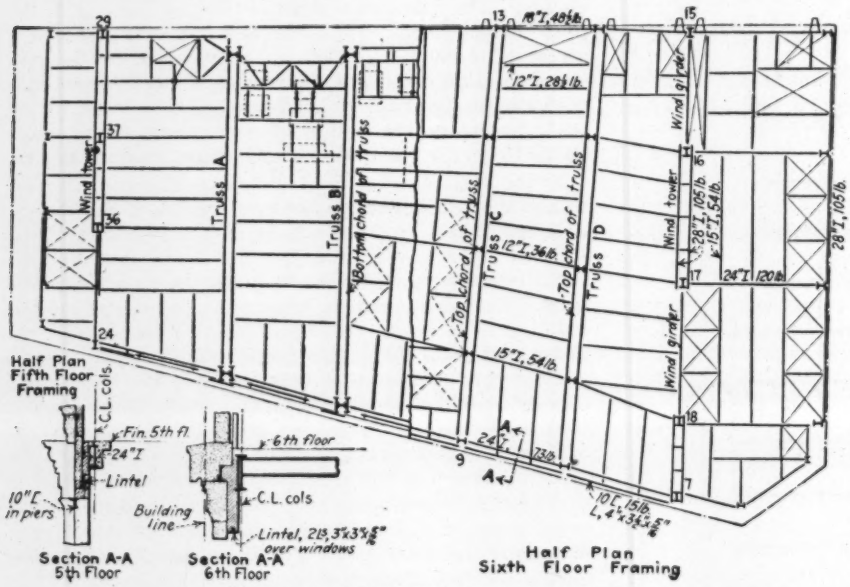


FIG. 3. TRUSS FRAMING PLANS

line of the passage in the fifth story. The upper end of this hanger was therefore forked as may be seen in Fig. 4, the passageway going through between its two arms.

All main truss connections were made with 1⅛-in. rivets, and the minor connections of other members in the truss have 1-in. rivets.

Erection of Heavy Trusses.—The erection of these trusses at such a height seemed likely to involve considerable expense in falsework, but the work was arranged in such a way that this expense was almost wholly eliminated. Steel columns, girders and beams intended for the upper part of the building were used in place of timber falsework up to the ceiling level of the board room; the hangers for the third and fourth floors were erected on this temporary structure, and, acting as columns, formed a support for the trusses. Thus the bottom chords of the trusses were placed directly on their hanger splice connections in permanent positions. The fifth floor framing was then set, forming a working deck and stiffening the structure, and the diagonals and top chords were erected in turn.

The heaviest unit to be handled in the case of each truss was the main section of the top chord. Two 50-ton derricks were used, and the maximum weight lifted by them was the top chord of truss *C*, which weighed 53 tons. No difficulty was found in the erection of the trusses other than was to be expected in the handling of such heavy pieces. The members fitted together perfectly, and the holes, which were all drilled from steel templets, were remarkably accurate.

When the trusses were completely riveted the temporary steel below the third-floor level was removed, and subsequently re-erected in its true position above. Credit is due to the steel contractors for the way in which they worked out the details of the scheme of erection, which was suggested by the consulting engineer. Selecting the right pieces and adapting them to their temporary uses, and calculating the temporary loads and stresses, involved considerable study, which was done with a thoroughness indicated by the facility with which the work proceeded in the field.

Wind Bracing.—Particular attention had to be given to the wind bracing of the structure in north-and-south

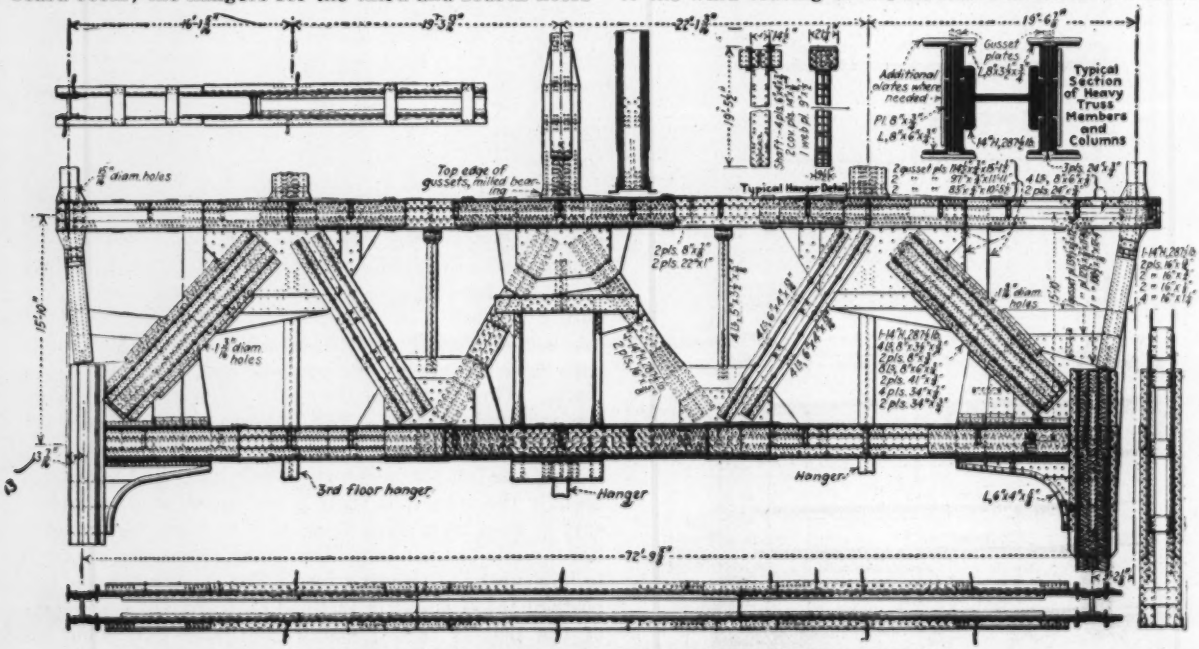


FIG. 4. DETAILS OF THE HEAVIEST TRUSS; SOUTH COLUMN AT RIGHT
Hanger detail and milled bearing of upper column also shown.

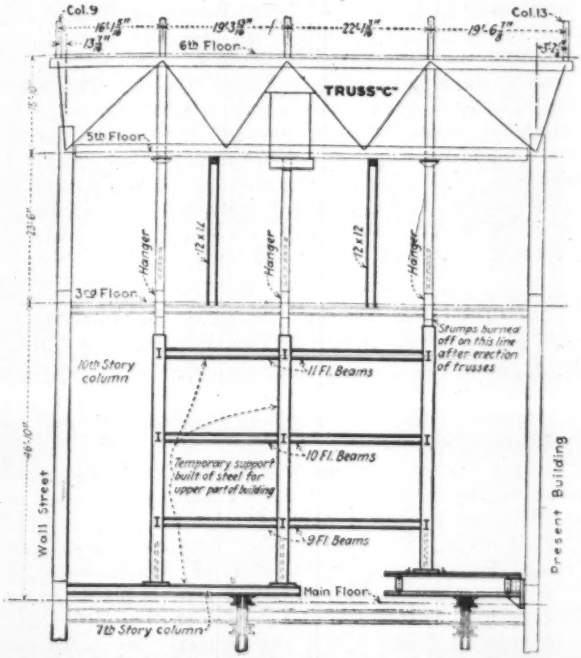


FIG. 5. UPPER-STORY STEEL USED AS FALSEWORK

location is accounted for by the offset at the eighth floor on the Broad St. front. At the west end there is no such offset, but the bracing could not be placed in the street wall because the floors directly adjoining the wall are so cut up by openings for elevators that they are not capable of transmitting the increment of shear from floor to wall.

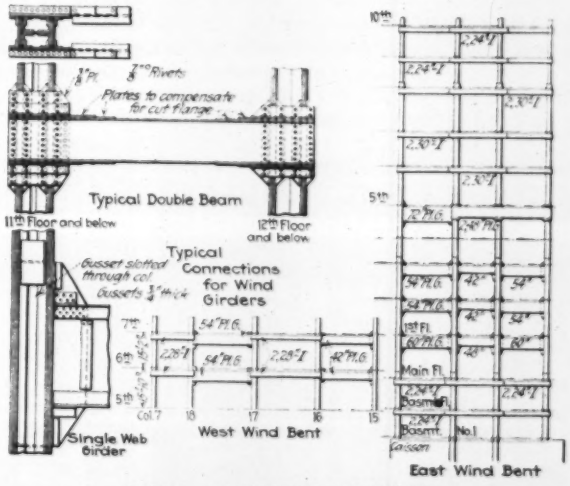


FIG. 6. WINDBRACING TYPES

direction. The central portion of the building having no interior columns in the lower stories, it was decided to make a stiffening bent of the four columns in the east or Broad St. wall (at ground level these columns are one bay west of Broad St.), and similarly of the five-column bent one bay from the west or New St. wall. The former

Both bents constitute rigid-joint square-panel frames with connections arranged within the depth of the girder as far as possible. Depending on architectural conditions, the horizontal members in these bents were designed either as single plate girders which connect to the columns by means of gusset plates slotted through

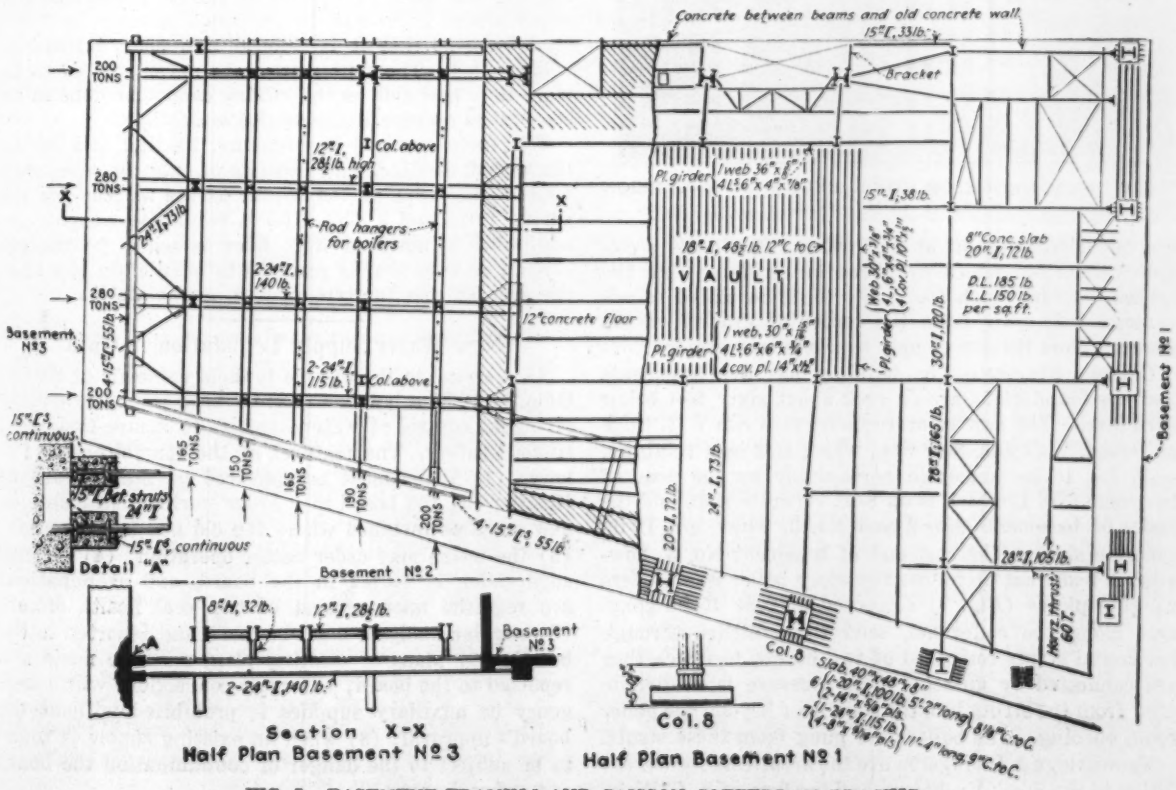


FIG. 7. BASEMENT FRAMING AND CAISSON COFFERDAM BRACING
This plan drawn to one-fifth larger scale than fifth and sixth floor plan, Fig. 3.

the column, or as double beams connected on either side of the column by means of angles (Fig. 6). The combination of moments caused by the wind, dead and live loads was calculated with great care and the connections designed accordingly.

An interesting detail occurs where the double beams connect to the interior columns of the wind towers. Owing to the fact that it is the *algebraic* sum of the separate girder moments which must be transmitted to the column, it was found best to run one pair of beams by a column to a point 3 ft. beyond the centerline, and there to splice to the next pair, developing in the splice

FIG. 8. FRAMEWORK OF STOCK EXCHANGE EXTENSION NEARLY COMPLETED

the calculated moment at that point. This made a column connection which projected but little outside the column and in which the rivets could be placed to advantage well away from the center of gravity of the group. Thus the use of ugly brackets was avoided.

Caisson Bracing.—The building has five basements and the foundations are on rock about sixty feet below curb level. The new reinforced-concrete rim 7 ft. thick on Broad, Wall and New Sts., which acts as a retaining wall, has to be supported horizontally by the floor of basement No. 1, which is an 8-in. concrete slab, and the floors of basements No. 2 and No. 3, which are 12-in. concrete slabs. The east end of basement No. 3, however, is badly cut up by the two-story boiler room. Here ranging pieces (Fig. 7) composed of four 15-in. channels along the cofferdam, send the pressure through horizontal struts composed of two beams, to which they are connected by gussets. The pressure is re-distributed from the struts into the solid floor beyond the boiler room opening. The boilers are hung from these struts.

Trowbridge & Livingston are the architects for the addition to the Stock Exchange, and the firm of S. C. Weiskopf designed the steel. Moran, Maurice & Proctor are the foundation engineers, who designed and superintended the cofferdam construction work, which was done by the Underpinning & Foundation Co. The building is being erected by Marc Eidlitz & Son, Inc. Levering & Garrigues are the contractors and erectors for the steel, and the work was fabricated at their plant at Dunellen, N. J. with the exception of the heavy columns and trusses, which were fabricated at the Bethlehem Steel Bridge Co. plant at Steelton, Pa. The total weight of the steelwork is about 5,660 tons.

Repairing Asphalt Streets in Winter

A METHOD of repairing asphalt pavements during the winter months, when municipal and county asphalt plants usually are closed down, has been evolved by Charles L. Harrison, engineer in charge of street repairs at Cincinnati.

The old asphalt pavement is removed from the streets and hauled to the yards during the regular working season, the pavement being broken down to approximately 2½ in. The heating plant consists of four horizontal four-wheeled kettles, each of 100-gal. capacity. The old asphalt, broken to proper size, is placed in the kettles in the afternoon and the fire started at 5 o'clock the next morning; 4 or 5 gal. of water are added and the covers are placed on the kettles. After being allowed to steam for half an hour the mixture is turned over with heavy bars, is spaded at one end and then allowed to steam again.

The operation is repeated until at the end of three hours the water has evaporated and the mixture is ready for use at a temperature of 325 to 375 deg. F. It is then transferred to another kettle, under which a hot fire has been built, and is hauled therein to the street where it is laid in the same manner as "new stuff," except that it is tamped into place instead of being rolled. The four kettles are never allowed to be more than half full, as the mixing cannot be done in an economical manner if the kettles are full.

The force engaged in breaking, heating and laying the asphalt in Cincinnati consists of only the seven men who are kept during the winter as the nucleus for the spring force and a driver for a two-horse wagon. No additional bitumen or dust filler is added to the old asphalt and the cost is reported to be slightly less than the average cost for repairs with new material.

New Water Supply Legislation in Ohio

As a sequel to the terrific typhoid epidemic at Salem, Ohio, in 1920, a law has recently been passed providing stringent control of water supplies to insure their continuous safety. The features of the control are as follows: (1) Plans must be approved by State Board of Health; (2) the board may order purification plants or new supplies installed where the old one is dangerous; (3) the board may order better operation; (4) general supervision is vested in the board, and examinations are required upon request of the local health officer; (5) regular analyses must be made and reported to the board; (6) plans of existing plant must be made and reported to the board; (7) cross-connections with emergency or auxiliary supplies is prohibited without the board's approval; (8) when an existing supply is found to be subject to the danger of contamination the board can order changes.

Dust Explosion and Collection in Grain Elevators

Difficult To Keep Elevators Clean—B. & O. R.R. Applies Dust Collection Equipment to Old Timber Elevators

THAT the dust explosion hazard is a factor in the structural design as well as the operation of grain elevators and certain other classes of industrial buildings has been shown clearly in articles on the wrecking of the Chicago elevator of the Chicago & Northwestern Ry. and on dust explosions in general, in *Engineering News-Record* of March 31 and April 14, pp. 560, 621 and 634. Many modern elevators, including the Chicago elevator, are provided with dust collecting equipment, but this deals only with dust produced in the handling of the grain within the building.

Rules made by certain grain authorities in regard to the operation of grain elevators prohibit the application of suction to the grain before it is weighed. In a paper read recently before the Western Society of Engineers, David J. Price, of the Bureau of Chemistry, U. S. Department of Agriculture, stated that for some time this Bureau has been recommending aspiration or the application of suction during the preliminary handling of the grain, in order to remove the dust before it has an opportunity to escape and accumulate in the elevator. He urged that the Northwestern explosion showed again the need for revision of this regulation.

The purpose of the prohibitory rule is to protect the shipper against reduction of weight of his shipment, but Mr. Price considered that safety to life and property demands its revision. He suggested that the shipper can be reimbursed for the dust and material removed, which has some value for cattle feed. Further, Mr. Price stated that where great quantities of grain are handled in a short time, the dust accumulates so fast that it is almost impossible to keep the elevator clean by ordinary methods of brushing and sweeping.

Baltimore & Ohio Elevators

An example of the application of dust collecting equipment to old elevators is afforded by the grain elevators of timber construction operated by the Baltimore & Ohio R. R. at its Locust Point terminal at Baltimore, Md. Early in 1920 it was decided to install a complete system for the collection and removal of dust in order to eliminate as far as possible the fire and explosion hazard and also to reduce the differential in fire insurance rates which applies to all grain handled through these elevators as compared with modern concrete structure. One elevator 100 x 330 ft., built in 1874, has a storage capacity of 1,200,000 bushels and is operated by the original installation of boilers, engine and line shafting. The other, 87 x 410 ft., built in 1881, has a storage capacity of 1,300,000 bushels and was converted to electric operation several years ago. In addition to the facilities for unloading grain from cars, each elevator has a marine leg with a capacity of 20,000 bushels per hour.

Besides installing the dust collecting system, it was considered desirable to include modern facilities for cleaning grain. The old cleaners were in the cupola of each house, where they constituted a considerable fire risk, were not readily accessible for adjustment and supervision, and in many cases involved an undue amount of handling of the grain. The new cleaner units are on the ground floor distributed so that as wide a range as possible can be served by each machine. In each house there are three machines having a capacity of 4,000 bushels per hour, fitted with sieves and screening brushes and operated by individual motors.

For collecting sweepings in each elevator, a complete sweeper system was installed, consisting of the usual equipment of fans, cyclones and galvanized iron pipe lines. Approximately one pick-up was provided for each 2,000 sq.ft. of floor space on the ground floor and all cupola floors. Discharge of dust from each cleaning machine is directly connected to the sweeper system through a cyclone for each individual cleaner. This sweeper system was designed to handle not only the dust but also the grain which necessarily collects on floor and is mixed with sweepings. Four fans for the sweeper system in the larger elevator discharge into a large cyclone which is located on the roof, directly over the dust bin. In the smaller elevator, dust collecting fans discharge into a small intake box, which is connected to a 6-in. underground pipe line leading to the dust room. Dust in this pipe line is handled by a blower in the dust house and is discharged directly into the dust bin.

Screenings which accumulate from each cleaner are collected in a small hopper under the floor, and are delivered to the dust house by a blower and 8-in. pipe lines. At the point of collection, bins are provided for the receiving and storage of screenings from each house. Screenings are then sacked and loaded into cars through a sack chute. Dust is loaded directly from the bin into box cars by a special screw conveyor, with an air blast for trimming dust in the car.

One man is required particularly for the operation of this system, his duties being the operation of machinery in the dust house and attending to the sacking and loading of screenings and dust. Operation of equipment throughout the elevators, including the sweeping of floors, cleaning of beams, etc., is handled entirely by the regular elevator force. The equipment was installed under the direction and supervision of L. P. Kimball, engineer of buildings, and T. H. Seal, superintendent of elevators, Baltimore & Ohio R. R. Stinson & Godfrey, Chicago, were the engineers and general contractors. The sweeper system and blow pipe work was installed by the Cyclone Blow Pipe Co., Chicago, and the "Airveyor" equipment was furnished by the Guarantee Construction Co., New York, as sub-contractor.

War Water-Works and Houses at Hopewell Sold

The 30,000,000-g.d. water-works plant built at Hopewell, Va., during the war to supply the munitions plant of the E. I. de Pont de Nemours Co. and adjacent villages has been sold by the Du Pont Chemical Co. to the Industrial Service Corporation of Virginia, which took possession Nov. 1. The works included pumping stations, filtration plant, and distribution system. The general manager of the purchaser is J. F. Muhlig, with headquarters at Hopewell. Recently the Du Pont Chemical Co. gave title to the last of the houses owned by it in one of the large villages in the Hopewell district. The transfer included 73 dwellings. Twenty firms have located at Hopewell since the movement to turn Hopewell and vicinity over to permanent industrial development was begun.

Experiences in Pneumatic Caisson Sinking in Mexico

Bridge Pier Sunk 80 Ft. With Green Labor—Caisson Provided With Open Well for Dredging Simultaneous With Pneumatic Work

By T. Hind
Special Engineer, Southern Pacific R.R. Co. of Mexico, Tucson, Ariz.

NATIVE Mexican labor was successfully employed last year in the construction of a somewhat complicated foundation for a bridge for the Southern Pacific R.R. Co. of Mexico across the Fuerte River, a turbulent stream, in the State of Sinaloa on the west coast of Mexico. A special feature was the use of a pneumatic caisson and open well excavation in the same pier at the same time.

In the original construction of the railroad in 1906-1907 the river was crossed by a so-called temporary bridge consisting of 750 lin.ft. of pile and timber trestle and twelve 70-ft. steel deck plate girders on substantially constructed pile and timber piers, the girders being placed on the south side of the river over the deepest portion of the channel and the strongest currents. The structure averaged about 40 ft. high from normal low water to base of rail.

The original structure was satisfactory and gave no trouble until the winter of 1919, the highest floods in the meantime being about 20 ft. But on Jan. 2, 1919, the river rose to a height of nearly 35 ft. above normal low water, washed out four piers at the south end of the bridge and dropped five sets of the steel girders into the river, some of these girders weighing nearly 70,000 lb. They were carried downstream several miles by the force of the current.

LOCOMOTIVE CROSSING SHOO-FLY TRESTLE JUST BEFORE IT WASHED OUT

As conditions at the time were not favorable to undertaking expensive construction, it was decided to replace the washed-out portion of the bridge practically in kind, first reopening traffic on a temporary track and depressed trestle on a shoo-fly alignment.

Owing to the war-time conditions of the markets in the United States, from which practically all material and supplies had to be secured, work on the main bridge was considerably delayed. There was also additional delay owing to the fact that the summer and fall of 1919 were unusually wet and the river consequently high. For these reasons the main bridge was not ready for reopening traffic until the morning of Jan. 11, 1920, when the first revenue train passed over, at which time a rise in the river had already commenced. By 5 p.m. of the same day the flood had risen to practically the same extreme height of the flood of a year before, washed out three of the new piers and dropped four sets of girders, and washed out the greater portion of the shoo-fly trestle, which had already been washed out and replaced twice during the summer floods.

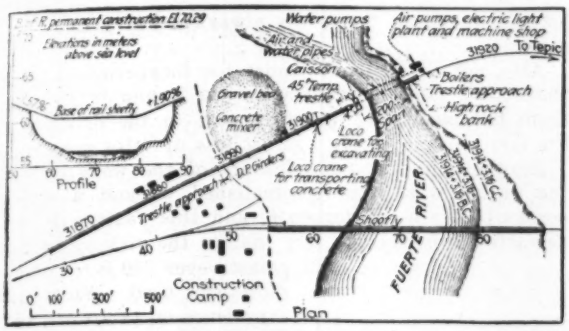
The floods both of 1919 and 1920 indicated scour in the river bottom of nearly 50 ft. to bedrock on the line of strongest current near the south end of the bridge and it seemed wise to span this region of greatest erosion with permanent construction. In view of the expensive maintenance of the shoo-fly trestle during flood periods it seemed wise to rush the work to completion before the summer floods.

A 350-ft. steel span would have been ideal for the situation but structural steel was still unreasonably high priced and quick delivery impossible to secure, so a 200-ft. span which the company already had in stock was decided on.

There was a good bedrock location for a pier to support the south end of this span practically at the south edge of the river but soundings for the pier at the north end indicated a necessary penetration of slightly over 40 ft. through sand, gravel, and large quantities of heavy riprap to a sloping surface of bedrock, into which there would have to be a penetration of 8 ft. on the north side of the pier in order to provide a proper bearing. The pneumatic caisson method of sinking seemed advisable. An effort was made to have the pier constructed by contract but various proposals from contractors were not satisfactory, and the unusual course of undertaking pneumatic caisson construction with the everyday working forces of the company was adopted; traffic, in the meantime, being again opened over the replaced shoo-fly trestle.

Together with the construction of the 200-ft. span with its necessary piers, some rearrangement of the remaining portion of the bridge was necessary in order to properly close the washout gap, the entire work consisting of one 200-ft. pin connected through truss of span, two 60-ft. deck plate girders, a short timber trestle, an ordinary concrete pier, a pneumatic caisson pier and one pile pier, with piling driven to bedrock.

Sounding for bedrock, designing, and the selection and purchasing of equipment and materials consumed a great deal of time, but by April 1 considerable material and some equipment was on the ground and actual work commenced. On April 3 all transportation on the company's lines was tied up by a general strike of train and engine men and simultaneously began the revolution which ousted President Carranza. The forces at the bridge were completely isolated from the outside world until April 26, when traffic was again reopened



PLAN AND PROFILE OF FUERTE RIVER BRIDGE SITE

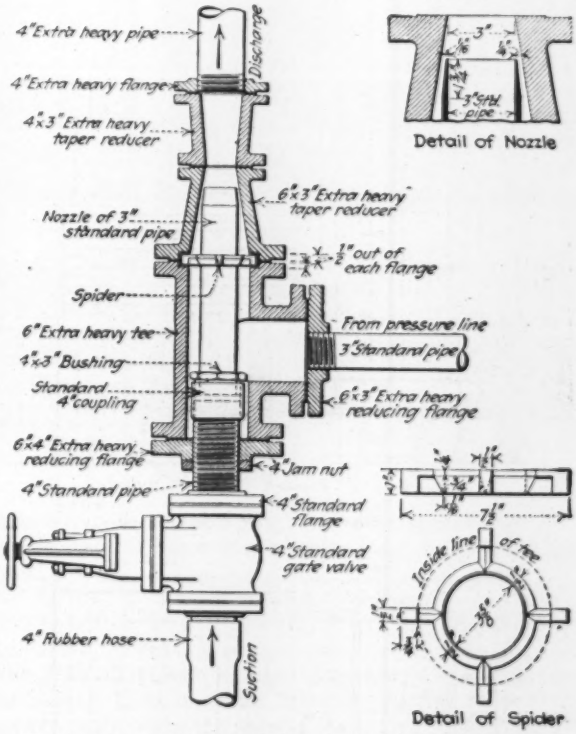
over the company's lines, only to find that, owing to the switchmen's strike in the United States, necessary equipment and materials were tied up all over the United States with very indefinite prospects of delivery.

Under these circumstances it seemed wise to abandon the idea of sinking the caisson before the summer floods, but a small force was continued on preliminary work, constructing camp buildings, the concrete pier at the south end of the 200-ft. span, and the pile pier north of the pneumatic caisson pier, the framing of the wooden shoe of the caisson, and the partial assembly of the power plant.

During the summer, floods were not sufficiently high to again wash out the shoo-fly trestle, and work on the main structure was recommenced about Oct. 1. Sinking of the caisson was commenced Oct. 20.

The pier sunk by pneumatic caisson consisted of concrete reinforced with old rails and with 36 in. of wooden shoe to cushion shocks of blasting, the cutting edge of the wooden shoe being reinforced with 8-in. channel irons. Facts regarding its design and construction may be tabulated as follows:

Horizontal dimension of caisson	20x50 ft.
Height of air chamber	9 ft.
Thickness of concrete ceiling poured before commencing sinking	6 ft.
Age of concrete in caisson at time sinking commenced	4 to 6 days
Penetration of caisson shoe below base of rail	79 ft. 3 in.
Penetration of concrete below caisson shoe	3 ft. 6 in., max.
Total penetration of pier below base of rail	82 ft. 9 in.
Total penetration of caisson in sand, gravel, riprap and solid rock	42 ft. 5 in.
Total penetration of caisson below normal low water surface	42 ft. 5 in.
Net Excavation	
Sand	543 cu.yd.
Gravel	526 cu.yd.
Heavy riprap	241 cu.yd.
Solid rock	165 cu.yd.
Concrete in pier	1,535 cu.yd.
Total lumber permanently in place in caisson and pier	49,000 ft.b.m.
Reinforcement	40 tons, 40 lb. relay rails and 4,080 lb. twisted steel.
Total hardware, inclusive of various shafts, forgings, bolts, etc	30,500 lb.
Chronological Data	
Shoe of caisson placed in position	Oct. 10
Commenced sinking	Oct. 20
Sinking completed	Dec. 3.
Air chamber filled with concrete	Dec. 6.
Pier completed	Dec. 15.
Progress	
Average rate of sinking in sand and fine gravel	3 ft. 7 in. per day.
Average rate of sinking in boulder gravel	1 ft. 10 in. per day.
Average rate of sinking in rip rap and solid rock	5½ in. per day.
Principal Equipment	
2—125 hp. stationary boilers.	
3—Straight line steam-driven air compressors total capacity	942 cu.ft. per min.
3—Heavy pressure duplex steam pumps	10x6x12 in.
2—4-in. hydraulic ejectors.	
1—Steam driven 9 kw. electric light plant.	
1—Portable 180 amp. hour gasoline driven storage battery. Electric light plant.	
2—Locomotive cranes—10-ton and 20-ton capacity.	
1—Orangepeel bucket, ½ cu.yd. capacity.	
1—½-yd. batch concrete mixer, complete with boiler and engine.	
1—Track pile driver.	
Schedule of Wages	
Common labor on surface	$1.25 per day
Handy labor on surface	1 75 per day.
Carpenters on surface	2 25 per day.
Sandhogs, first 10-ft. penetration	2 25 per day.
Sand hogs, second 10-ft. penetration	2 50 per day.
Sand hogs, third 10-ft. penetration	2 75 per day.
Sand hogs, fourth 10-ft. penetration	3 00 per day.
Foremen, stationary engineers, etc	$125 to $150 per month with board.



HYDRAULIC SAND EJECTOR USED IN FUERTE RIVER BRIDGE

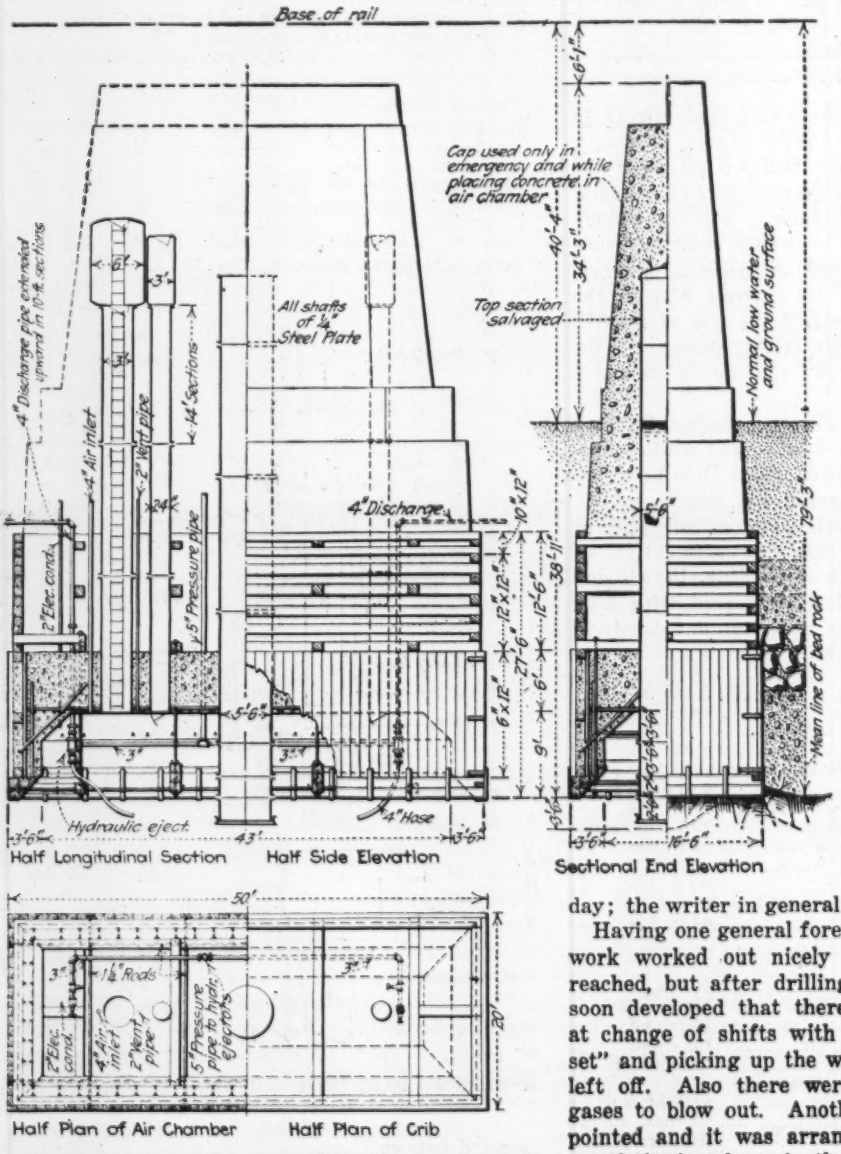
General foremen	$200 to $225 per month with board.
Blacksmiths, machinists, etc	$3 to $5 per day.

Working time—8 hours per day (4 hours on and 8 hours off) for sand hogs and machine men actually engaged in sinking caisson, and 10 hours per day for others.

All common laborers, sand hogs, mechanics, clerks, and foremen, also the master mechanic and two general foremen were native Mexicans. They were absolutely inexperienced in pneumatic caisson work and steel bridge erection. In fact, there were only three men on the rolls in addition to the writer who had ever

seen a pneumatic caisson, and these three had to be discharged very early in the game because of Bolsheviki tendencies. From laborer to general foremen they were resourceful and faithful and soon caught on, not only to the practice but also to the principles and theory of what they were doing. They also worked much more steadily than it is generally supposed that Mexican workers do.

In quantity performance the writer believes that, considering all the conditions, good results were obtained.


Base of rail
Cap used only in emergency and while placing concrete in air chamber
All shafts of ¼" Steel Plate
Top section salvaged
Normal low water and ground surface
Mean line of bed rock
4" Discharge pipe extended upward in 10-ft. sections
4" Air inlet
2" Vent pipe
14' Sections
1.5" Pressure pipe
2" Elec. cond.
4" Discharge
Hydraulic eject.
4" Hose
Half Longitudinal Section
Half Side Elevation
Sectional End Elevation
Half Plan of Air Chamber
Half Plan of Crib

DETAILS OF PNEUMATIC CAISSON BUILT AND OPERATED BY MEXICAN LABOR

The riprap and solid rock through which the caisson was sunk were very difficult and the difficulties were increased by the thick strata of very open gravel penetrated. In sinking through the upper stratum of sand there was no difficulty in keeping the water surface from 6 in. to 12 in. below the cutting edge of the caisson, but after the open gravel was reached it was impossible to lower the water surface more than an inch or two below the highest point of the cutting edge, and at the least disturbance there was always a heavy inflow of sand.

Also, not a bad performance for inexperienced men, the 200-ft. pin connected span was swung in 13 days from the placing of the first seat to the driving of the last pin and safety against loss of false work.

Another quite unusual feature of the work is that the entire work was accomplished without a single accident of any consequence, and this feature is not detracted from by the fact that in the sinking of the caisson over 700 lb. of dynamite was used. From his experience on this work and on other work, the writer believes that the Mexican people are capable of quite high industrial development if proper general conditions can be secured in their country.

The supervising organization might by some be criticised as topheavy and unnecessarily expensive, but it must be remembered that inexperienced men were doing work of quite special nature. During the sinking of the caisson there was a master mechanic in general charge of the power plant, 24 hr. per day; three general foremen on the surface, 8 hr. each per day; one general foreman in charge of air chamber work, on duty 24 hr. per day in case of emergency, but in routine putting in two hours in the air chamber with each gang of sand hogs; three sand-hog foremen and three sub-foremen, 8 hr. per day; one concrete and general purpose foreman on the surface, 10 hr. per day; the writer in general charge with no specific hours.

Having one general foreman in charge of air chamber work worked out nicely until the heavy riprap was reached, but after drilling and blasting commenced it soon developed that there was too much lost motion at change of shifts with the incoming gang "getting set" and picking up the work where the outgoing gang left off. Also there were blasts to fire and powder gases to blow out. Another general foreman was appointed and it was arranged that a general foreman spend the last hour in the air chamber with each outgoing shift and the first hour with each incoming shift. The results were good. Ten sand hogs working four hours on and eight hours off were worked in each of the three air chamber gangs until the heavy riprap was reached and afterwards as many as could be packed into the air lock, an average of from twenty to twenty-five.

As the season in which the caisson was sunk was not one of positive low water, plans for the prosecution of the work had to be based on the possibility of floods of medium extent.

The main power plant was located on the high solid

rock south bank of the river above the reach of any possible flood, the pumps being placed at the foot of the bank in such a way that flooding would not damage. A 4-in. air line from the air compressors and a 5-in. water line from the pumps were carried across the river channel to the location of the pier on floats, 40 ft. of the air line being looped below the water surface for cooling purposes. Connection of air and water between the pipe lines and the caisson were made with links of fire hose.

From the remaining northern portion of the bridge, falsework was extended as a work track to the location of the pier. On the extreme end of this falsework a locomotive crane was placed to handle the dredging, etc.

The concrete mixer was placed in the bed of the river about 300 ft. to the north and alongside of the bridge both for the purpose of being above probable flood waters and of being convenient to a good bed of gravel. The mixer was served by another locomotive crane which also transported the mixed concrete in a bottom dump bucket dumping it into a hopper in the track behind the dredging crane. From this hopper the concrete flowed under the dredging crane in a galvanized iron chute to the caisson.

The wooden shoe of the caisson had been framed and assembled on the north bank of the river about 400 yd. distant from the location of the pier the previous spring. In the fall when work was commenced there was about 5 ft. of water at the pier location. The location was enclosed by a slip constructed of timber, piling, brush, and wire to protect against floods, and filled to the water surface partly by silting and partly by dredging and the caisson shoe was skidded to place.

The necessary forms, outside 6 x 12-in. sheeting, various shafts, and piping were placed after the timber shoe was landed and concrete poured to a depth of 6 ft. above the ceiling of the air chamber, a very rich mixture, 6 sacks of cement to the cubic yard of river gravel being used to a height of 12 in. above the ceiling, and above this an ordinary mixture of 4 sacks to the yard was used.

Four days after the completion of the pouring of the concrete to the 6-ft. line sinking was commenced; perhaps a rather risky procedure as the concrete was very green, but no harm resulted.

The construction of the caisson was very satisfactory. Usual preparations were made in advance to stop leaks when air pressure was first turned on but there were no leaks either at this time or subsequently.

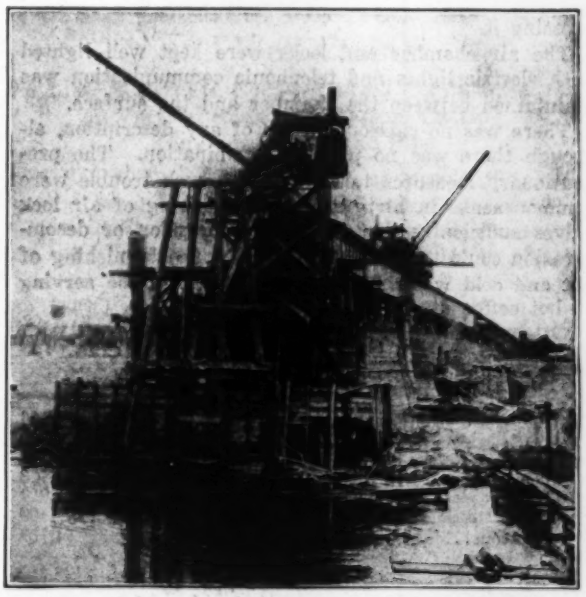
The removal of excavated material from the air chamber was accomplished by hydraulic ejectors or sand pumps by blowing out with air and by dredging with an orange-peel bucket through an open shaft or water column 5 ft. 6 in. in diameter. All the methods worked satisfactorily.

The hydraulic ejectors were, to the best of the writer's knowledge, original in design, being constructed practically altogether by the assembly of ordinary commercial pipe fittings. No attempt was made to determine their actual capacity, but with the water-supply at from 90 to 100 lb. pressure they ejected all the sand or gravel that could be fed to them and without any trouble except an occasional plugging with material too large to go through.

At about 20 ft. penetration the material became too coarse for the ejectors; the nozzles, etc., were removed and the same hose and ejector pipes were used to blow material through with air. Even in the heavy riprap and solid rock these air guns were of good service, considerable quantities of accumulating spalls, gravel, and sand being ejected through them.

The orange-peel bucket in the open dredging shaft or water column was effective in every way. Rocks of several cubic feet contents were grappled and removed. When rocks too large to be thus removed, or solid rock, was encountered at the bottom of the shaft, it was broken, either by blasting, if this seemed the most convenient way, or by dropping a rock breaker through the shaft from above.

The rock breaker was a small box girder bridge seat built up of four extra heavy 10-in. I-beams with miscellaneous web and cover plates, the whole securely riveted together. By manipulating it the same as a



WORKING ON THE CAISSON OF THE FUERTE RIVER BRIDGE

pile-driver hammer through the dredging shaft, with the locomotive crane above, quite large rocks could be quickly broken if they were loose or detached, but it was too light to have much effect on solid rock.

The bottom of the dredging shaft extended 2 ft. 6 in. below the cutting edge of the caisson so as to provide leeway in case material encountered should prove sufficiently tight to enable the water surface to be held conveniently below the shoe of the caisson, but if working again in material so open as that encountered actually proved to be, the writer would not extend the shaft more than perhaps a foot or, at the most, a foot and a half below.

Blasting in the air chamber was done by drilling, by snakeholing in crevices, and by driving loaded 1¼-in. pipe in seams. The heaviest single charge placed was 3 lb. of 40 per cent dynamite and the heaviest blast consisting of a series of holes eleven pounds. Firing was done by a blasting battery located in the air lock, the lower door of the lock being closed but the pressure not equalized.

In the first 30 ft. penetration no difficulty from skin friction was encountered and it was never necessary to reduce air pressure. At this point the caisson become

badly bound in rock and very drastic reduction was necessary for all penetration secured until sinking was finally completed. Pressure was reduced at each shift change, the general air chamber foreman on duty at the time throwing both 4-in. ejector pipes and a 2-in. ventilation pipe wide open and blowing down to 3 or 4 lb. pressure. At this stage of reduction the air chamber would be filled with water to within 3 or 4 ft. of the ceiling, but when the valves were closed and the three compressors started full force the chamber would be unwatered by the time the incoming shift had reached the bottom. This blowing out also served to clear the air of powder smoke.

The highest air pressure used in actual sinking was 18 lb., but in filling the air chamber with concrete as high as 31 lb. was used for the purpose both of crowding the concrete under the cutting edge and of compressing it.

The air chamber and locks were kept well lighted with electric lights and telephonic communication was maintained between the chamber and the surface.

There was no caisson disease of any description, although there was no physical examination. The precautionary measures taken to avoid such trouble were common sense in hiring men, the bushing of air lock valves sufficiently that neither compression or decompression could take place too rapidly, the furnishing of hot and cold water bathing facilities, and the serving of hot coffee at each change of shift.

Cost of Work

The estimated cost of the work was as follows:

Concrete pier on south side of river	$4,893
Pneumatic caisson pier	79,579
Pile pier north of caisson pier	7,374
200-ft. pin connected truss span, complete with track	25,508
2-60 ft. deck plate girders, complete with track	5,950
Permanent trestle	300
Miscellaneous	4,763
Total	$128,359

In the light of the comparatively cheap labor prices involved the substructure costs may seem high, but cheapness did not extend to equipment, materials, and supplies. As typical samples, cement cost approximately $5.50 per bbl., f.o.b., at the river, and coal cost $10 per ton. The steel superstructure units were, however, in stock prior to the development of war bridge prices, and were charged out to the work at about 3c. per lb.

The work was handled under the general direction of the late Epes Randolph, president, and L. H. Long, vice-president, of the company, with the writer in direct charge of design and construction. W. E. Schley, Division Engineer of the Sonora Division, served as chief assistant and rendered very valuable services.

Oxygen Consumed Varies with Concentration Cornell Investigation Shows

After an elaborate set of tests at Cornell University on the recommended method of determining the oxygen consumed in sewage and other heavy concentrations it has been found that the amount indicated in dilution varies with the strength, being greater for the weaker solutions. However, the variation is in accordance with mathematical formulae which John Scacciaferro worked out and reported in the October *Cornell Civil Engineer.*

Cement Stucco Covering for Small Railway Buildings

A CHEAP and durable type of construction for houses of section foremen and laborers and for small stations and office buildings, which has been developed on the Nashville, Chattanooga & St. Louis Ry., consists of a wood frame sheathed with wire mesh over or woven with, building paper and covered with 1 in. of stucco appiled by the cement gun process. Fig. 1 shows the general construction for section houses, some of the details being given in Fig. 2.

Composition red shingles on ¾-in. tongued and grooved sheathing cover the roof. Ceilings and inside walls are of ½-in. pine ceiling or of plaster on electrically welded lathing. At the corners of all openings the stucco is reinforced by sheets of the wire mesh, with paper removed, these sheets being placed diagonally, as shown. The wire mesh often used is electrically welded, with building paper between the woof and warp, the latter being placed next to the studding. In some cases, tarred felt has been used, being tacked in place before the wire

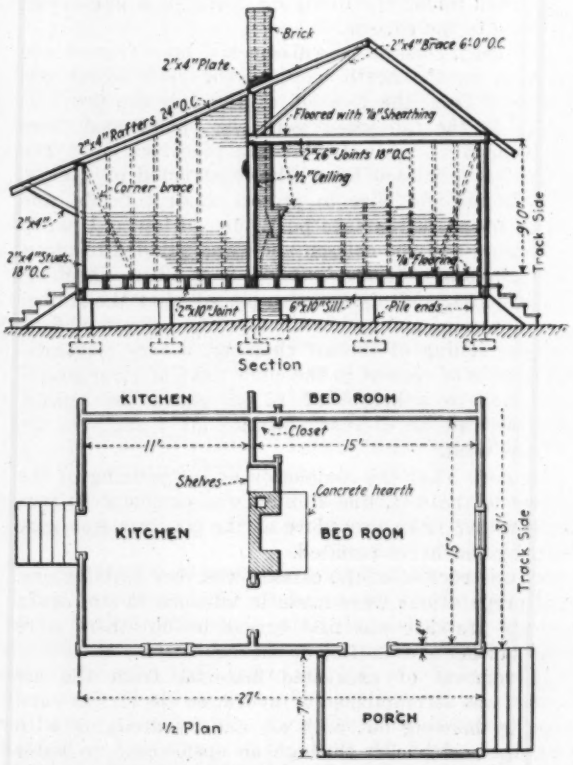


FIG. 1. SECTION LABORERS' HOUSES OF STUCCO ON WIRE MESH AND WOOD FRAME

mesh is applied. Wood trim with which wet stucco will come in contact is first given two coats of paint to prevent swelling and subsequent shrinkage cracks. Outside trim is painted brown, with window sash black, the interior being light buff. All painting is three-coat work.

The section laborers' buildings are for two families, with a kitchen and bedroom for each, the bedroom having a brick fireplace and concrete hearth and the kitchen having a stove flue. About 75 per cent of the track laborers are negroes. A four-room house for the section

foreman is built on the same general plan, but with doors provided in the two interior partition walls, one porch being omitted and two of the doors replaced with windows.

Similar construction has been used for two-story buildings for storehouses and yard offices, but these have usually plank storm sheathing, over which paper or felt and wire mesh are applied on furring. A stucco covering has been applied also to old frame and brick buildings, the brick being cleaned with wire brushes or

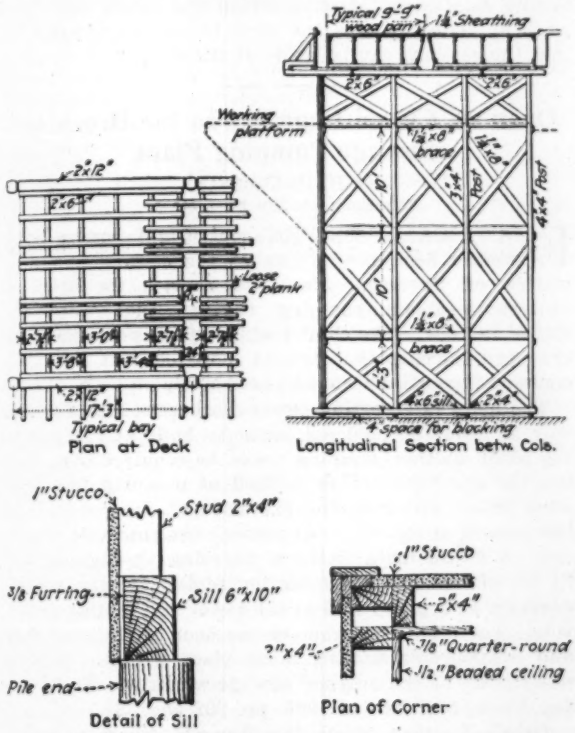


FIG. 2. DETAILS OF HOUSE WITH STUCCO COVERING

by sand blasting with the cement gun. Old section houses of boxing and batten construction have been successfully coated with the stucco. In doing this, the battens are first removed and all exterior trim is adapted to the stucco treatment, inserting nailing grounds where needed. The paper backed wire mesh is applied with fence staples, the staples not being driven clear home in order that the stucco may get a grip behind the wires.

The 1:3 mixture of cement and sand is passed through a ½-in. screen, moderately coarse and slightly damp sand being preferable to very fine dry sand. Pressures of 35 lb. of air at the gun and 50 lb. of water at the nozzle are recommended in the railway company's instructions, the water supply being regulated to give a plastic mixture that will remain on the wall without flowing or sloughing. The nozzle is held usually about 3 or 4 ft. from the wall.

Two coats of stucco are applied, preferably with an interval of not more than half an hour between them. The first ¾-in. coat (½-in. on old buildings) is screeded to a plane surface and then a ¼-in. second or "flash" coat is applied for a smooth finish. While the latter is still wet, it is brushed lightly with a wet whitewash brush, to secure uniform color and texture, the stucco being then kept sprinkled for two or three days. Corner and frieze boards, steps and similar parts are applied to grounds in the stucco after it has set.

With present prices and conditions, the cost of a double section house complete is about $2,700. If the exterior walls were of pine drop-siding, with three coats of paint, the saving would be only $125, and there would be the expense of painting at intervals of four or five years. As the stucco requires no such maintenance, it shows a real economy. There is little trouble from cracking or spalling of the stucco, if it is properly applied. This style of building construction and repair, begun in 1914, has been developed gradually under the direction of Hunter McDonald, chief engineer of the Nashville, Chattanooga & St. Louis Ry., the work being done by the forces of the engineering department.

Porous Concrete for Well Strainers and Well Casing

No Fine Aggregate Used—Precast Sections Strung on Vertical Rods with Bottom Cutting Edge—Interior Sand Pipe

CONCRETE of high porosity as a substitute for the usual brass well strainer and steel casing is a new development for water supply wells in gravel and sand formations which has been applied in several cases for depths up to 130 ft. A porosity of about 22 per cent in volume is obtained by removing all sand from the aggregate, the concrete being a 1:4 mix

FIG. 1. POROUS CONCRETE FOR WELL STRAINER

made with gravel screened to reject all material retained on a No. 5 screen and all that passing through a No. 12. Typical crushing strengths are 1,110, 1,626 and 2,633 lb. per square inch for ages of 7 and 28 days and 2 months respectively. The appearance of the concrete is shown in Fig. 1.

This well casing, Fig. 2, is made in 48-in. lengths reinforced with ¼-in. steel rings and having eight 1¼-in. pipes for vertical rods or bolts. The bearing surfaces are mortised and are put together with 1:3 cement mortar. With an internal diameter of 36 in. and a wall thickness of 5 in. the 4-ft. section has a weight of 1,523 lb. and gives an external area of 37.7 sq.ft. Its porosity permits a flow of about 10 gal. per minute per square foot of external surface. There is said to be less clogging or choking of sand around the concrete than around a brass strainer, so that there is less diminution of flow with age.

To sink a concrete-lined well, a 40-in. riveted steel

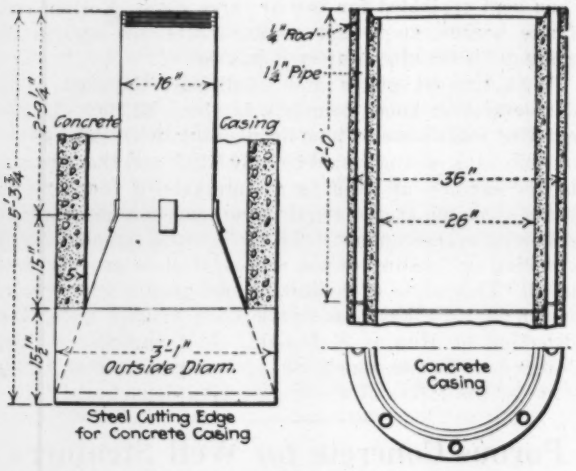


FIG. 2. CONCRETE WELL CASING AND STEEL CUTTING EDGE

casing with Z-bar cutting edge, Fig. 3, is driven down to the water bearing stratum, the casing being suspended in a steel derrick frame and the inclosed material being excavated by an auger or sand pump. Into this casing the porous concrete lining is lowered, as in Fig. 4, the bottom section resting on and being bolted to a funnel-shaped cutting edge (see Figs. 2 and 3). To the smaller end of this funnel is screwed a 16-in. pipe which serves to lower the casing and in which the sand-bucket excavator operates. This method of working protects the concrete from abrasion or injury by the bucket.

When five sections have been lowered, the sand is pumped out, causing the concrete casing to sink. Additional sections are placed and the operation is repeated until the desired depth is reached. Then the temporary steel shell is withdrawn, the bottom of the well is sealed with concrete, and finally the 16-in. pipe is cut off near the cutting edge and pulled up.

Greater rate of flow and more permanent flow are claimed as advantages over brass strainers, the low velocity of the water due to the large inlet area causing little movement of fine sand towards the well. In a recent well the velocity to and through the strainer was only 2.125 in. per minute. This porous concrete well casing is patented and is manufactured by the Well Casing & Strainer Manufacturing Co., Alton, Ill. For work at distant points the steel forms are shipped so that the sections can be made at the site.

FIG. 3. STEEL SHELL FOR CONCRETE WELL

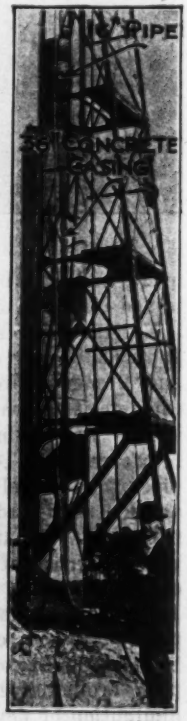


FIG. 4. CONCRETE CASING

Open vs. Closed Impellers in the Brockton Sewage Pumping Plant

By H. S. CROCKER,
City Engineer, Brockton, Mass.

ELECTRICALLY-DRIVEN centrifugal pumps have recently been put in use at the sewage pumping station of Brockton, Mass., to replace the original equipment—steam pumping engines—that were installed in 1894. The chief feature of the new pumps is the open impeller that proved more efficient than the enclosed type after tests had been made on each.

The main intercepting sewer discharges into a reservoir of about 500,000 gal. capacity built at the pumping plant, so that pumping would be required only during the day time. This method of pumping has long since lapsed owing to the extension of the sewers and the growth of the city. At present the reservoir serves only to afford more uniform pumping throughout the 24 hr. of the day. The suction piping for the pumps connects at a pump well at the lower end of this reservoir. There is little grade to the floor of the structure and considerable settling takes place within. (For a description of the original sewage-works see *Engineering News*, first half of 1895, pp. 292 and 334.)

Originally there were two 5-m.g.d. steam pumping engines, designed to raise 5,000,000 gal. of sewage in 24 hr. to a height of 46 ft. through 16,650 ft. of 24-in. cast-iron force main to the disposal works.

As time progressed the steam pumping plant became more and more inefficient, partly due to age and partly due to the fact that with the building of the sprinkling filter plant it became necessary to elevate the sewage 16 ft. higher; and of course the friction head had slightly increased during this time. Good judgment required that it be replaced by a more modern plant.

Estimates prepared by the writer in September, 1917, for electricity, oil and steam as motive power showed that the installation of electrically-driven centrifugal pumps would be cheapest not only as far as first cost was concerned but also when considering maintenance. The Sewerage Commission therefore decided to ask for bids for this type of a plant.

The specifications required that three electric motors directly connected to centrifugal pumps be furnished; one unit to lift 2,000,000 gal. and each of the other two units to lift 3,500,000 gal. of sewage 62 ft. through 14,650 ft. of 24-in. pipe in 24 hr. to the disposal plant. The length of force main was decreased 2,000 ft. at the time of the construction of the sprinkling filters. Synchronous motors were specified for the larger sizes because the local Edison Co. offered an extra 10 per cent

discount from its bills if this type of motor was installed for sizes of 75 hp. or over. The type of equipment as well as efficiencies were left to the bidders. The contract stated, however, that tests for capacity and efficiency of the units would be run both at the factory and at Brockton after being erected, before acceptance.

Bids were received and the contract was awarded in December, 1917, to the Power Equipment Co., of Boston, whose bid of $12,750 was the most satisfactory one for the city. Its efficiency guarantees were as follows: the small pump, 72 per cent; the larger pumps, 73; overall of small unit, 64; overall of larger units, 66 per cent. The temperature-rise guarantee above room temperature for the motors was 50 deg. C. on the synchronous motors and 40 deg. C. on the squirrel-cage motors.

Pump and Motor Specifications

The pumps were manufactured by the DeLaval Steam Turbine Co., Trenton, N. J. They are of single-stage, double-suction, single-impeller type. The small pump is 8 in. in size and is designed to run at 1,750 r.p.m. The two larger pumps are 10 in. in size and their speed is 1,200 r.p.m. The pumps are of such design that they can readily be dis-assembled, and all parts can be inspected without disturbing the suction or discharge pipe connections. The impellers, as originally furnished, were of the enclosed type, but since the first test they have been replaced by open type ones. Each pump was originally provided with special patented sewage wearing rings, dividing the suction and discharge chambers. They are designed to eliminate wear, and are arranged to be self cleaning, and to prevent stoppage in the impellers. A special form of stationary cast-iron sleeve surrounding the rotating sleeve, locked into the pump casing at one end and butting the impeller at the other end, is furnished to prevent winding of strings, rags, etc., around the shaft. These pumps are directly connected by flexible couplings to motors manufactured by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. The small pump is driven by a 40-hp. squirrel-cage induction motor, and the larger pumps by rotating-field synchronous motors, each having a full load of 75 hp. when impressed with 3-phase, 60-cycle, a.c. at approximately 2,200 volts. These two motors have a 1.25-kw., 125-volt direct-connected exciters for furnishing exciting current when running. The motors are started and brought to approximate synchronous speed as induction motors. When this speed is attained, the auto-transformers are cut out and full line voltage is impressed on the stator, the exciter is connected to the rotor windings and the motors fall into synchronism.

The plant was put into operation in May, 1919. It was to have been tested immediately or as soon as the 500,000-gal. receiving reservoir was cleaned—that is, the sludge pumped out so that the pumps could be tested to maximum lift. This reservoir served in a dual capacity—both as a regulator of the sewage flow so that pumping could be at a uniform rate and als served as a partial settling basin. The new pumps could not raise the sludge 17 to 18 ft. although it was well diluted with water. The contractor thereupon started experimenting with an open-type impeller in order to accomplish the work that the enclosed impellers could not do. Before a suitable one was shipped to Brockton a year had passed by without the reservoir being cleaned once.

This new impeller was installed on Jan. 5, 1920, and after experimenting with it for a week the real cleaning began. It lasted until the thirtieth of the month, at which time all sludge had been removed. The sludge contained quantities of sand, cotton waste, grease, etc. It was broken up by the incoming sewage and also by hydrant streams, and flowed to the pump well at about the consistency of oatmeal. Men were continuously raking the bar screen between the reservoir and the pump well, and during the cleaning period removed from the screen 58 cu.yd. of material. This was a small part of the actual sludge, which was estimated at 1,000 cu.yd.

Acceptance tests were conducted on these pumps on April 21, 22, and 23. Each pump was tested twice—first taking the sewage directly from the main sewer, protected only by the bar screen; and second, taking the settled sewage from the reservoir. The pumps failed to pass test in either output or efficiency, as shown in the following table:

Unit	Gallons Delivered per Minute		Per Cent of Overall Efficiency	
	Contract	Test	Contract	Test
1	2,450	2,380	66	59.5
2	1,400	1,240	64	47.5
3	2,450	2,410	66	58.5

The test on Unit 1 was connected with the open impeller instead of the enclosed or contract impeller.

The contractor claimed that the failure to come up to guarantee was the result of the hard usage the pumps received during the year before the test, and especially during the cleaning of the reservoir. Owing to the fact that the pumps had performed so satisfactorily—pumping water—in the shop tests at Trenton, the contractor was granted another chance with new impellers to prove that the pumps could do the work. The Power Equipment Co. was satisfied that the larger waterways of the open-type impeller were necessary to do the work, especially as the Pump 1 had been tested with the open impeller, and they, therefore, requested that the DeLaval Co. make the open-type impellers. Work was immediately started on the design of the new impellers. They were installed in January, 1921, and acceptance tests were conducted in February. Through a misunderstanding the Venturi meter was not calibrated previous to the tests, but as no adjustments had to be made to it when calibrated before the previous tests this work was waived until afterwards and tests were conducted. This was unfortunate as after tests the Venturi people did not calibrate but adjusted the meter. The actual readings of the meter were therefore not as reliable as had been expected. The figures of the last test are accordingly not absolutely reliable:

Unit	Gallons Delivered per Minute		Per Cent of Overall Efficiency	
	Contract	Test	Contract	Test
1	2,450	2,695	66	65.1
2	1,400	1,240	64	63.3
3	2,450	2,710	66	64.8

These figures show that the pumps exceeded the output requirements by a considerable margin and that the efficiencies of the units were very close to contract guarantees.

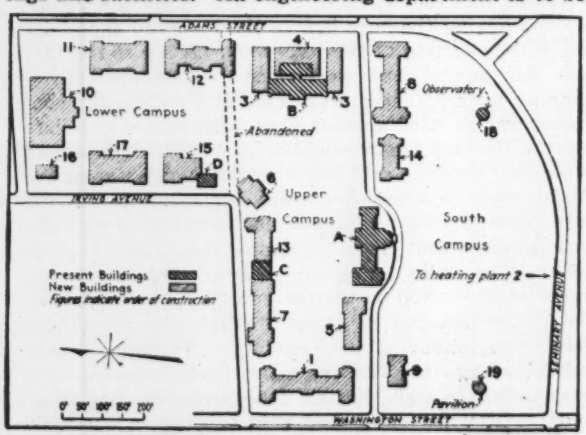
There is absolutely no comparison between the two types of impellers for small high-speed pumps as far as sewage work is concerned. The open impeller pumped far more liquid in the final test than did the closed impeller even in the shop tests at Trenton. And as seen

by the figures, there is no comparison in the efficiencies. The contractors made the claim that wear was the cause of the inefficiencies in the 1920 tests. There is no doubt that there was considerable wear but the real work and the real wear was not on the closed impeller of Pumps 2 and 3 but on the open impeller of Pump 1, which was designed only for high suction lift with a heavy material to pump. Regardless of that fact, its output in the 1920 tests was only 30 gal. short of the closed impeller and the overall efficiency of that unit was a whole per cent higher. Strange as it may seem, there is no doubt as far as pumping Brockton's sewage is concerned—even when that sewage is settled and very dilute—but that an open-type impeller properly designed will give a greater output and a higher efficiency than the enclosed one for small high-speed pumps even when the impellers are new.

Program for 20-Year Expansion of Small College

Engineering Department to be Established and Several New Buildings Erected at Total Cost of $2,680,000

A PROPOSED expansion of Wheaton Congregational College at Wheaton, Ill., has been planned on a comprehensive program extending over a term of 20 years in order that the completed institution may be harmonious in the style and arrangement of its buildings and facilities. An engineering department is to be



PROPOSED EXPANSION OF WHEATON COLLEGE

Present buildings: A, Main building; B, women's dormitory and dining hall; C, gymnasium (to be taken down); D, academy (to be moved).

New buildings: 1, Men's dormitory; 2, heating plant; 3, additions to women's dormitory; 4, dining hall; 5, history and English; 6, library; 7, men's dormitory (first section); 8, women's dormitory; 9, administration; 10, gymnasium; 11, science; 12, women's dormitory; 13, men's dormitory (second section); 14, chapel; 15, academy; 16, hospital; 17, engineering.

added as part of the expansion. This program calls for the expenditure of about $2,680,000.

Wheaton college, founded in 1848, has at present a four-story main building 75 x 190 ft., a women's dormitory, a gymnasium and an academy for preparatory students. At the rear of this last is a heating plant which serves all the buildings. The first two structures shown in black on the accompanying plan, will be retained, although remodeling of the main building is included in the program. New buildings of the proposed scheme are shown by hatched areas.

From a study of the growth of the institution it was concluded that in 20 years the number of students would be 1,200, if the necessary facilities were made available. A somewhat higher capacity would be provided by the instructional buildings as planned, but the dormitories would accommodate only about 900, as a certain number of students live at home or in private residences. The main building is on the crest of a slope toward the south, and as there is plenty of room toward the north, this slope is to be left practically undisturbed. All the buildings are to front on a large interior space comprising the present campus and a new campus, the latter being within two blocks of the present athletic grounds. A new heating plant would be located on the low ground adjacent to the Chicago & Northwestern Ry. For the new buildings, an English gothic style of architecture is proposed, the structures to be of reinforced concrete, with brick and stone walls and tile or slate roofs. The present main building is of buff stone and the dormitory is of red brick.

PROPOSED BUILDINGS FOR WHEATON COLLEGE

Building	Size, Feet	Stories	Cubic Feet	Cost
1. Men's dormitory No. 1	235 x 90	3	612,800	$270,700
2. Heating plant	$125,000 for first unit, total			235,000
3. Wings on women's hall	115 x 40	3	441,600	198,800
4. Dining hall	115 x 70	1	241,500	85,000
5. History and English	127 x 47	2*	243,700	97,500
6. Library	74 x 54	2	95,200	57,000
7. Men's dorm. No. 2 (first sec.)	190 x 45	3	391,200	177,000
8. Women's dormitory No. 2	200 x 90	3	552,000	248,500
9. Administration building	75 x 45	2	135,000	61,000
10. Gymnasium	170 x 84	2	662,400	200,000
11. Science hall	136 x 82	2	428,800	171,500
12. Women's dormitory No. 3	170 x 90	3	480,000	216,000
13. Men's dormitory, add. to No. 2	160 x 45	3	320,000	143,000
14. Chapel	60 x120	1	380,000	190,000
15. Academy building	92 x 47	2*	181,000	72,500
16. Infirmary (move old academy and remodel)				15,000
17. Engineering hall	136 x 82	2	428,800	171,500
18. Observatory	.....	..	.....	20,000
19. Pavilion	.....	..	.....	10,000
20. Grounds	.....	..	.....	30,000
21. Remodeling main building	.....	..	.....	10,000
Total				$2,680,000

*No basement.

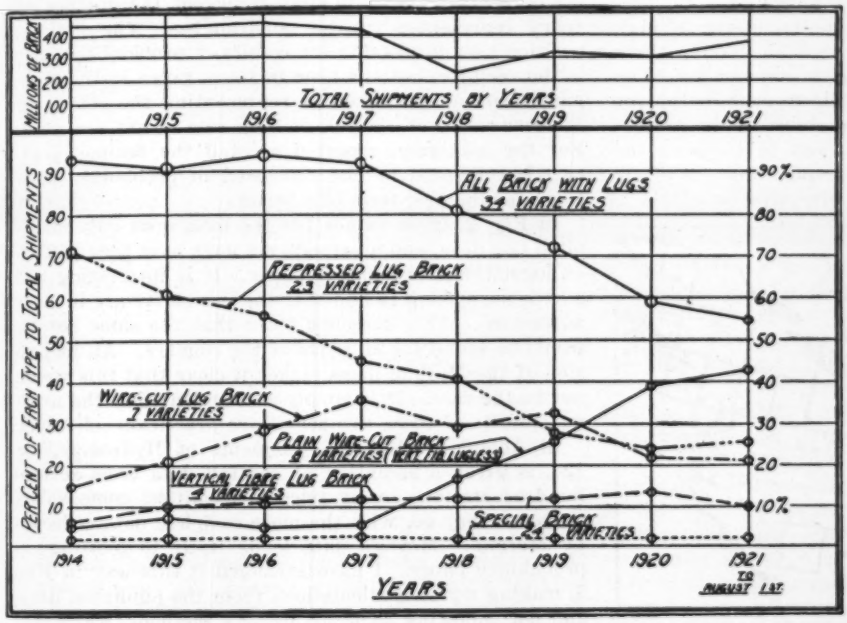
Figures noted on the plan indicate the order in which the buildings would be constructed, but no dates are set as the progress would depend upon financial conditions and the growth of the institution. The sizes and estimated costs of the several structures are noted in the accompanying table. This program of enlargement has been worked out by Wolf, Sexton, Harper & Truax, engineers and architects, Chicago. Dr. C. A. Blanchard is president of Wheaton College.

Tie Shortage on Indian Railways

The problem of maintaining the supply of ties in India, both for renewals and for new construction, is becoming more acute every year, according to the report of the Railway Department for the year 1919-1920. As supplies of native hardwood that can be used without treatment are limited experiments are encouraged with ties of various materials in order to develop substitutes that will be satisfactory under the conditions of Indian railways. A creosoting plant is being built for treating native soft woods, its capacity being 300,000 ties annually, but completion of the plant has been delayed considerably. Several types of reinforced-concrete ties are on trial, but most of these are still in the experimental stage. Pressed steel trough ties and cast iron ties consisting of pairs of bowls or plates connected by tie bars are used extensively, the latter forming a type of track construction distinctive of the Indian railways but used also in South America.

Many Varieties of Paving Brick Shown by Survey

IN RECOMMENDING the adoption of only 11 varieties of vitrified paving brick, in place of the 66 varieties which have been on the market from 1914 to date, representatives of paving brick manufacturers and engineering societies, who met in Washington, D. C., Nov. 15, with officials of the Department of Commerce, as noted in the news section of this journal Nov. 17, p. 831, based their conclusions largely upon a comprehensive report of a variety survey in the vitrified paving-brick industry made by the National Paving Brick Manufacturers Association for the U. S. Department of Commerce. A summary of the report follows:


MILLIONS OF BRICK
TOTAL SHIPMENTS BY YEARS
PER CENT OF EACH TYPE TO TOTAL SHIPMENTS
ALL BRICK WITH LUGS 34 VARIETIES
REPRESSED LUG BRICK 23 VARIETIES
WIRE-CUT LUG BRICK 7 VARIETIES
PLAIN WIRE-CUT BRICK 8 VARIETIES (VERT. FIB. LUGLESS)
VERTICAL FIBRE LUG BRICK 4 VARIETIES
SPECIAL BRICK 24 VARIETIES
YEARS
TO AUGUST 1ST

VARIETY TREND OF PAVING BRICK SHIPMENTS, 1914-1921 (AUG. 1)

In the shipment of 66 varieties of vitrified paving brick from 1914 to 1921 there were five major divisions of type, each with a variable number of sizes included as follows: (1) Plain wire-cut brick (vertical fiber lugless), 8 varieties; (2) repressed lug brick, 23 varieties; (3) special brick, 24 varieties; (4) vertical fiber lug brick, 4 varieties; (5) wire-cut lug brick (Dunn patent), 7 varieties. Each size of product, according to its type, is designated as a variety in the report.

The classification in Table I demonstrates the trend and status of variety according to type of brick, this year's figures being as of Aug. 1.

TABLE I. VARIETIES OF PAVING BRICK SINCE YEAR 1914

Type of Brick	'14	'15	'16	'17	'18	'19	'20	'21
Plain wire-cut (v.f. lugless)	5	6	7	7	6	7	5	6
Repressed lug	16	18	20	20	18	16	15	14
Specials	15	12	16	12	14	16	11	7
Vertical fiber lug	4	4	4	4	4	3	2	2
Wire-cut lug (Dunn)	3	3	5	5	5	5	7	7
	43	43	52	46	47	47	40	36

The data in the report are based upon replies from 44 companies operating 64 plants in 16 states. The total annual tonnage of brick produced is normally 4,245,300, or approximately 90 per cent of the total productive capacity of the entire industry.

The position of each type of brick during each year since 1914 is shown in Table 2, in which "1" signifies the brick in highest proportion, "2" the next highest, and so on to the lowest which is "5." In general the distribution of types shows that up to and including 1918 the pre-dominant brick was of the repressed type with lugs. In 1919 the wire-cut lug brick had the ascendancy, closely followed, however, by repressed lug brick and plain wire-cut brick. In 1920 and 1921 the plain wire-cut brick is the predominating type.

TABLE II. TYPES OF BRICK CLASSIFIED IN ORDER OF PRODUCTION VOLUME

Type of Brick	'14	'15	'16	'17	'18	'19	'20	'21
Plain wire-cut brick (v. f. lugless)	4th	4	4	4	3	3	1	1
Repressed lug brick	1st	1	1	1	1	2	2	2
Special brick	5th	5	5	5	5	5	5	5
Vertical fiber lug brick	3rd	3	3	3	4	4	4	4
Wire-cut lug (brick (Dunn)	2nd	2	2	2	2	1	3	3

An analysis of each type of brick by sizes indicates that two sizes stand out predominantly; they are 3½ x 4 x 8½ in., and 3 x 4 x 8½ in. In 1921 these two sizes constituted 83.1 per cent of all brick shipped; the 1921 shipments were about equally divided between the two prevailing sizes.

A sharp upward trend of the combined shipments of the two prevailing sizes of brick began in 1918 and reflects a tendency toward simplification of variety, following the wartime depression of industry. As the quantity of shipments has increased the proportions of the 2 sizes and 10 varieties has grown at the expense of the remaining 56 varieties shown in the report.

Cores Taken from New Jersey Roads Aid Research

Cores obtained by drilling through the pavements of New Jersey highways, according to R. B. Gage, chemical engineer of the state highway department, indicate the wisdom of not permitting the coarse and fine aggregate to be dumped on the sub-grade. Evidently a great deal more of this sub-grade material got mixed with the aggregates during handling than was thought possible. This sub-grade material, Mr. Gage points out, frequently is very deleterious. The effect of permitting concrete to be dumped on a muddy, soft sub-base has also been noticed in the samples taken. Irregularity in the contour of the sub-base is shown quite plainly by the cores; there is a variation in height of nearly 4 in. The borings also will be utilized as a means of studying drainage conditions of the sub-base.

The Frequency of High Rates of Rainfall

A Probability-Method Study of Data for the Eastern and Middle Western States in Morgan's Miami Technical Reports, Part V, and Meyer's "Elements of Hydrology"

BY ALLEN HAZEN,
Civil Engineer, New York City

ARTHUR E. MORGAN, Chief Engineer of the Miami Conservancy District, Ohio, has collected data for high rates of rainfall in the eastern part of the United States. (Part V, Miami Technical Reports.) All the records of the U. S. Weather Bureau were brought into a series of tables and diagrams showing the rain-producing capacity of the climate in every part of the eastern United States. Apparently this is the first time that these splendid data have been examined in a comprehensive way to learn from them the frequency of high rates of rainfall. Mr. Morgan's work in making these results available cannot be too highly commended. The data are in a form that lends itself to examination by graphic probability methods. The object of the present study is to apply such methods, and to compare the results so reached with similar results from carefully collected but less extensive data otherwise available.

FIG. 1. MAP SHOWING LOCATION OF RAINFALL QUADRANGLES

In the Morgan report the data are summarized by quadrangles of latitude and longitude, extending two degrees in each direction. All of the data for each quadrangle are combined as if they formed a single record, and results taken from this combined record are shown in figures printed upon the maps of the Miami report. To study average relations between time intervals and varying degrees of rainfall intensity, a limited number of quadrangles were selected. The basis of the selection was to take those that had the most numerous data. All quadrangles showing over 500 years were first taken. There are 28 such quadrangles. (See map, Fig. 1.)

TABLE I. INCHES OF RAINFALL IN SELECTED QUADRANGLES

Twenty-eight Quadrangles	Decimal Position	Maximum Day	Maximum Two Days	Maximum Three Days	Maximum Four Days	Maximum Five Days	Maximum Six Days
Once in 15 yr.	0.0667	4.15	4.98	5.43	5.79	6.17	6.42
Once in 25 yr.	0.04	4.73	5.63	6.21	6.57	6.91	7.20
Once in 50 yr.	0.02	5.43	6.35	7.03	7.45	7.84	8.19
Once in 100 yr.	0.01	6.14	7.44	8.12	8.62	8.94	9.23
Maximum in record.	0.00071	9.21	10.36	10.80	11.67	11.86	12.60
Six Quadrangles							
Once in 15 yr.	0.0667	4.02	4.88	5.08	5.38	5.68	5.90
Once in 25 yr.	0.04	4.67	5.63	6.05	6.35	6.60	6.90
Once in 50 yr.	0.02	5.25	6.18	6.88	7.22	7.60	8.00
Once in 100 yr.	0.01	6.10	7.30	7.97	8.40	8.70	8.90
Maximum in record.	0.00064	9.10	11.10	12.20	12.90	13.00	13.30

The data from these 28 quadrangles were then summarized. A like summary was made for the six North Atlantic quadrangles covering New England, except Maine, southern New York, eastern Pennsylvania, New Jersey, and parts of Maryland and Delaware (Fig. 1). The results of this study (Table I) show first the amount of rainfall in inches to be expected for the maximum day in 15, 25, 50 and 100 years, and in the period corresponding to the average of the number of years represented in the quadrangles. The decimal position used in plotting the results on probability paper is the reciprocal of the time in years given in the Morgan report and is taken as representing the chance of the occurrence of rainfall of high rate in any one year. For the maximum reported rainfall the decimal position is computed by the rule used in probability plottings for the first term of a series.

In Fig. 2, these values for the maximum day, maximum two days, and maximum six days have been plotted on logarithmic probability paper. It is interesting and a little surprising to find that the two series are in close agreement. This does not mean that the same results would be found for all parts of the country. An inspection of the Morgan maps makes it clear that this would not be the case. It is simply an accident that the average results of these two series are practically identical.

In Adolph F. Meyer's "Elements of Hydrology," p. 124, is given a summary of rainfall data from several hundred stations in six selected localities, comparable, as far as they go, with the more complete data collected by Morgan. Meyer's data lends itself to plotting on probability paper. I have arranged it this way in Fig. 3, making my own calculations from the published data, and not following some of Meyer's methods, which are not appropriate for this purpose. Table II shows the numerical values corresponding to the plotting and also the rates of precipitation to be equaled or exceeded once in 10 years and once in 100 years, scaled from

TABLE II. MEYER RAINFALL DATA FOR HIGH RATIO OF RAINFALL IN SIX DISTRICTS (See Fig. 3)

	Alabama	Minnesota	Ohio	Eastern Kansas	Central Kansas	Western Kansas
No. of stations	65	72	100	42	38	26
No. of years	15	20.75	15	15	15	15
Station years	975	1,490	1,500	630	570	390
Ratio of number of daily precipitations above limit to number of years in record:						
9 in.	0.0031	0.0013	.....	.....	.....	.....
8 in.	0.0082	0.0027	.....	.....	.....	.....
7 in.	0.0205	0.0047	0.0020	0.0095	0.0017	0.0025
6 in.	0.0440	0.0087	0.0047	0.0223	0.0035	0.0077
5 in.	0.1080	0.0161	0.0080	0.0650	0.0175	0.0205
4 in.	0.3400	0.0605	0.0340	0.1560	0.0750	0.0665
3 in.	1.0200	0.2250	0.1530	0.4950	0.2700	0.1590
2 in.	3.8800	0.9650	0.8800	1.9600	1.2300	0.6850
1 in.	15.8000	5.4000	6.9500	8.7500	6.4500	4.0500
Once in—						
10 yr., in.,	5.1	3.6	3.3	4.5	3.8	3.5
100 yr., in.,	7.8	5.7	4.8	6.9	5.4	5.7

the plotting. These values may be compared with Morgan's. In Fig. 31 of the Miami report are shown the maximum 24-hr. precipitations to be expected once in 100 years, in all parts of the eastern United States. I have taken from this approximate values corresponding to Meyer's districts. The corresponding figures side by side are shown in Table III. The check between

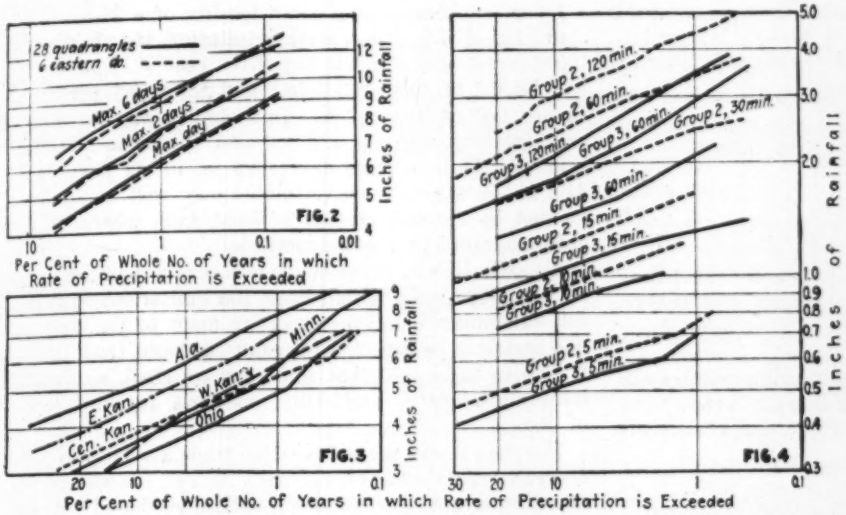


FIG. 2. COMPARISON OF HIGH RAINFALLS IN THE 28 AND THE 6 QUADRANGLES
FIG. 3. HIGH RAINFALLS FOR ALABAMA, OHIO, KANSAS AND MINNESOTA, PLOTTED FROM MEYER DATA
FIG. 4. MEYER RAINFALL DATA PLOTTED BY INTENSITY GROUPS

Meyer's and Morgan's values for the same districts is close. On an average Morgan's values are 3 per cent higher. The agreement is satisfactory and adds confidence to the use of the data.

TABLE III. COMPARISON OF MEYER AND MORGAN DATA

District	Daily Precipitations in Inches Equaled or Exceeded Once in 100 Years	
	Meyer	Morgan
Minnesota	5.7	5.5
Ohio	4.8	5.3
Eastern Kansas	6.9	7.5
Western Kansas	5.7	5.5
Central Kansas	5.4	5.6
Alabama	7.8	8.0
Average	6.0	6.2

There have been frequent compilations of high rates of precipitation for periods ranging from 5 to 120 minutes. Charles W. Sherman's article on the 26-year record at Springfield, Mass., *Engineering News-Record*, Sept. 2, 1920, p. 445, and Kenneth Allen's analyses of New York data, *Engineering News-Record*, April 7, 1921, p. 588, and H. P. Eddy's figures in the *Journal* of the Boston Society Civil Engineers, February, 1921, may be mentioned.

Meyer in his Hydrology, p. 144, attempts a general classification of this kind of data in groups, according to the intensities of precipitation at the various stations. His work may be compared with Morgan's, though the data used are much less numerous. His map on p. 151 of his book shows the classification of the country into groups. This resembles in a way Morgan's Fig. 31, showing the maximum 24-hr. precipitation to be expected in 100 years.

Meyer's Groups 2 and 3 cover, in a general way, that part of the country corresponding to the 28 quadrangles. In Fig. 4 are plotted Meyer's data for these groups, showing the rates of precipitation to be expected in 5, 10, 15, 30, 60 and 120 minutes. Solid lines are used for Group 3, and broken lines for Group 2.

In Fig. 5 I have brought together Morgan's data for the 28 quadrangles and Meyer's data for short periods of intense precipitation, using values intermediate between those found for Group 2 and Group 3, and to those I have added figures for annual and monthly rainfall based on 45 in. mean. This plotting is logarithmic in both directions. On it have been drawn lines showing the rates of precipitation at which there is one chance in 10, one in 100, one in 1,000, and one in 10,000 of being exceeded in one year. The last one (or two) values were obtained by extending the appropriate lines of the preceding figures on logarithmic probability paper. These indicated extreme values are to be taken only as rough approximations but perhaps give a better idea than is otherwise available as to the probable occurrence of extreme rates. All of the values shown by this and the preceding diagrams relate to probable precipitations at one observation station. They must not be taken as applying to considerable areas, because precipitations are not the same even at stations a short distance apart. The probable precipitation on any considerable area will be less than that at a particular station.

The marked variation in the direction of the lines in the different parts of their course suggests that there are certain periods in rainstorms. Very heavy intensities last, at most, from one to two hours. It is unfortunate that we do not have 4- and 8-hr. records for comparison; but the maximum day's rainfall is only 50 per cent greater than the corresponding 2-hr. rainfall. It seems that the hardest rainfalls usually work themselves out in a 2-hr. period, and only moderate rates are to be expected immediately before and after.

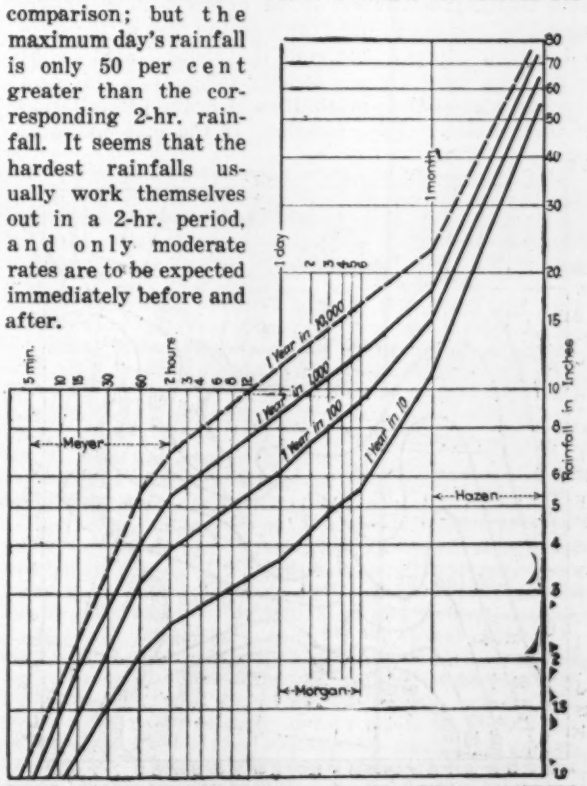


FIG. 5. COMPARISONS OF MORGAN AND MEYER RAINFALL INTENSITY DATA, WITH ADDITION OF ANNUAL AND MONTHLY RAINFALLS BASED ON 45-IN. MEAN

Some interesting and useful ratios may be obtained from these data. These ratios are between the maximum precipitations occurring in longer and shorter periods of years, and also during varying numbers of minutes, hours and days. All the data are very consistent in these ratios and only the average results are here given, in Tables IV and V.

TABLE IV. RATIOS OF AMOUNTS OF PRECIPITATIONS IN EQUAL TIME INTERVALS OF DIFFERENT DEGREES OF PROBABILITY

	Morgan's Data 1 to 6 Days	Meyer's Data 5 Minutes to 2 Hours
10% chance in any one year	0.60	0.70
1% chance in any one year, taken as starting point for computing ratios	1.00	1.00
0.1% chance in any one year	1.45	(1.32*)
0.01% chance in any one year	(2.00*)	(1.68*)

* Extrapolation beyond limits of actual data.

TABLE V. RATIOS OF MAXIMUM PRECIPITATIONS OF EQUAL PROBABILITY IN VARIOUS TIME INTERVALS

Calculated for 1 percent chance in any one year, but approximately applicable to other degrees of probability

6 days	1.48	From Morgan's data
5 days	1.42	From Morgan's data
4 days	1.36	From Morgan's data
3 days	1.29	From Morgan's data
2 days	1.19	From Morgan's data
1 day	1.00	Basis
12 hr	0.88	Interpolated from logarithmic plotting
6 hr	0.77	Interpolated from logarithmic plotting
3 hr	0.69	Interpolated from logarithmic plotting
2 hr	0.64	Combination of Morgan's & Meyer's data
1 hr	0.50	Combination of Morgan's & Meyer's data

These ratios may be applied directly to the value found for any locality by an examination of Morgan's Fig. 31 (here reproduced as Fig. 6). This shows the maximum 24-hr. precipitation to be expected in a 100-yr. period, by means of lines drawn on the map of the eastern United States. Applying the above stated ratios to the base value for any locality taken from this map gives an idea of the probabilities of heavy precipitation in that locality. For example: If the map indicates a 1 per cent chance at a given locality of a 24-hr. precipitation of 6 in., then the precipitation, the chance of the occurrence of which in any given year is 10 per cent, will be 0.6 of this or 3.6 in.; and for a 0.1 per cent chance 1.45 of it or 8.7 in. In a similar way for other time intervals there is a 1 per cent chance in any one year of 7.14 in. in two days; 8.9 in. in six days, and 4.62 in. in 6 hr. Such estimates may well be supplemented by detailed studies of local data, where available, examined by similar methods.

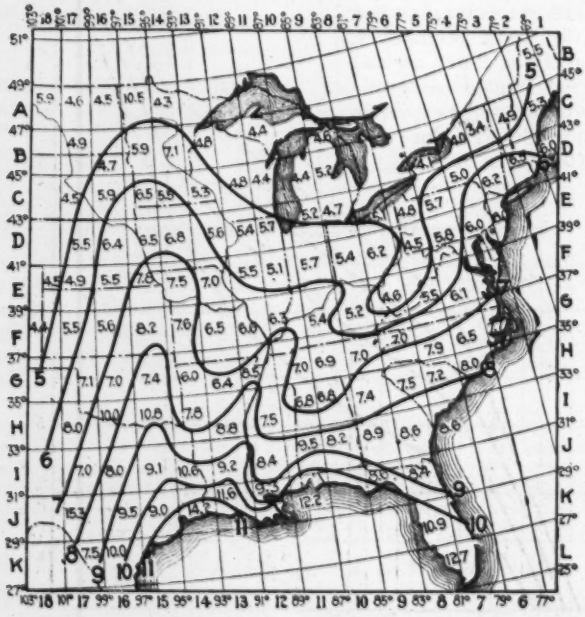


FIG. 6. MORGAN'S 100-YEAR EXPECTATIONS OF 24-HOUR PRECIPITATION FOR THE EASTERN UNITED STATES

An estimate can never be more accurate than the data on which it rests. We all know the limitations of rainfall observations, and the errors in many of the records will certainly be reflected in results deduced from them. It is also to be said that some day we shall, no doubt, have much better probability methods for this kind of data.

For the present the information made available by the Morgan report adds very greatly to our knowledge on this important subject; and estimates based on it, though by no means precise, may be useful in many undertakings.

Electrification of Logging Equipment In the Pacific Northwest

The electrification of logging railroads and the substitution of electric yarders and loaders for steam donkeys working in the woods is a subject of general discussion in the lumber industry of the Pacific Northwest and a few electrical installations have been made. Factors to be considered in making changes of this sort were reviewed in a paper by E. J. Barry, electrical engineer, Tacoma, Wash., presented at the recent Pacific Logging Congress at San Francisco. The following has been abstracted from his paper:

One of the principal advantages of electricity in logging operations is in the fuel saving. Refuse from the sawmill will supply all the power required in a logging operation at a cost much below that which would be entailed in developing the same power with fuel oil, coal or wood. Unlike the steam engine, motors require no water and the colder the weather the better operating conditions become; these are distinct advantages in many parts of the woods. As compared to steam power, the greater hauling capacity and higher speeds of electric locomotives makes it possible to render the same service with less number of locomotives and hence fewer train crews.

After experiment with single-phase and three-phase alternating current, the present practice favors high voltage direct current. Reasons for this are (1) that direct current gives good speed control with easy acceleration, (2) it can be used for regenerative control, that is, the motors of a locomotive on the down grade act as generators to pump energy back into the line, and (3) direct current can be used for dynamic braking with great saving in wear of brake shoes, wheel faces and rails.

The electric locomotive requires much less in upkeep than does the steam locomotive and will operate for at least twice the mileage without requiring overhauling in the shop. The saving in operating costs of electric over steam railroads would be from 30 to 35 per cent with a decided increase in output and independence of outside sources of fuel. However, the high initial cost of electrification makes it economical only if operations are to extend over several years. There is no doubt that the next few years will witness an era of electrification on those logging operations where favorable conditions obtain, in keeping with the present rate of progress to be noted in main line railroad electrification.

Some Thoughts on Long-Span Bridge Design

Architectural Considerations Controlling—Aesthetics and the East River Bridges—Towers for Delaware River Bridge Too Utilitarian—Wire Cable Problems and Eyebar Chain Possibilities

By Gustav Lindenthal
Consulting Engineer, New York

JUST before the calling of bids on construction of piers for the Delaware River suspension bridge, the Philadelphia section of the American Society of Civil Engineers on Nov. 7 devoted a meeting to that enterprise. At that meeting Gustav Lindenthal, the noted builder of the Hell Gate arch and now chief engineer of the Hudson River bridge project, presented a discussion in which he criticized one or two features of the design as published in "Engineering News-Record" of June 23, 1921, p. 1086, notably the unprecedently large wire cables and the towers. The views he expressed constitute a remarkable outline of fundamentals in the design of long-span bridges, particularly suspension bridges. They are given with slight condensation.—Ed.

EVERY unusually large bridge project offers new problems of construction, and it is a laudable although infrequent practice to offer up the plans for discussion by engineers before they are carried out. In this wise more or less valuable views and experiences on the subject may be exchanged or contributed that may be of benefit to the project and so also to the whole profession.

Architectural Features of Long-Span Bridges

Any large bridge should be designed with a view to fine architectural appearance. That much at least is due to a civilized age and it is particularly important in a city bridge. Every large bridge, even when it is unsightly, has a monumental character from its very hugeness, and causes wonderment. But it should do more than that: it should also give the beholder a feeling of pleasure and enjoyment. That is the essence of architectural art, and the more perfectly it is attained the greater the merit of the work and the greater the regard for the sciences and the arts and for their disciples, who create and leave it to posterity as a proof of culture and progress.

In the case of the proposed Delaware River bridge at Philadelphia the studies seem to have been confined to the cantilever form and the suspension form of bridge.

Cantilever and Arch Bridges—A cantilever bridge is the least adaptable to artistic treatment, but a large span can be given an imposing architectural appearance by the thoughtful engineer, through choosing a pleasing silhouette and through adroit differentiation of the bridge members so that they will express in their form and massiveness the forces they resist. A satisfying aesthetic form for a very long cantilever span as in this case would, however, require the arching of the lower or compression line of the superstructure below the line of roadway, as was done in the two large spans of the Firth of Forth bridge in Scotland, having about the same length as the river span in the Delaware bridge. In the well-known Quebec cantilever bridge, the bottom edge of the structure also descends below the floor line, but unfortunately in straight lines, thus giving the bridge an amateurish appearance and unnecessary ugliness. It is regrettable that the graceful lines of the first Quebec cantilever design were not retained, because it was in its outlines and conception a meritorious design, but collapsed under its own weight; not enough metal had been put into it.

An arch bridge is the next in aesthetic value. From arch designs of nearly 3,000 ft. span (over the Straits of Messina) worked out in considerable detail it is known that arch bridges of very long span offer decided advantages over cantilever bridges, where the shores offer good abutments. But in the case of the Delaware River bridge, for which the government required unobstructed width above the river, it was plain from the first that some type of suspension bridge would best satisfy local conditions. No time should have been wasted on a cantilever design.

It was then a question what kind of suspension bridge. One should think that nearly any kind of suspension bridge would satisfy aesthetic demands, because the graceful curves of suspended cables, nature's beauty line, could not be spoiled by the callousness of man. But that such can be the case, was the experience in the Williamsburgh Bridge, the second bridge built over the East River. No architect was consulted in the shaping of the bandy-legged towers or in the clumsy anchorages, nor were the stiffening trusses made sightly with any thought of forming a harmonious combination with the cables. The result is an unnecessary ugliness which even the untutored mind beholds with surprise. That structure has the distinction of proving how unsightly even a suspension bridge can be made if you try.

Towers—It should be the aim of the bridge architect designing a large suspension bridge, especially in city surroundings, to emphasize its monumental character in its most prominent feature, that is, the towers. They should satisfy the innate desire to give dignity to the structure. It has found expression in all larger suspension bridges, some of them built a century ago. Stone was invariably used for the towers. To this fact all the old suspension bridges owe their reputation for beauty, whether it was of the rugged kind as in the early English and American structures or of the more refined and ornamental kind as in some of the Continental suspension bridges.

The Brooklyn Bridge, completed 38 years ago, was the last suspension bridge with stone towers. The explanation is simple. High stone towers for very long spans are heavy and require big foundations, which are costly when they must be placed under water on deep rock. Metal towers are lighter and cheaper. But up to fifty years ago, cast iron was the only metal that could have been used as a substitute for stone towers and that only for limited heights. Only after the iron rolling mills became capable of producing heavier rolled shapes was it feasible to fabricate large metal towers of rolled iron and steel to take the place of stone towers. The designing of large metal towers as an art is therefore rather young, and only a few good examples of artistic metal bridge towers exist in smaller bridges.

Steel versus Stone—From the aesthetic point of view, metal towers, no matter how finely designed, will never equal stone towers. The finest example of an artistic metal tower is the Eiffel Tower in Paris, which carries no load but its own weight. And yet as an architectural creation it does not impress the beholder with that feeling of dignity and majesty which he experiences at the sight of any of the great spires in famous cathedrals. Although the highest inspiration of the architect as also the cunning skill of the artisan will probably always prefer stone to metal as building material for monumental work, the modern architect is obliged to also use steel and iron. He must create his own precedents in that material, and a large suspension bridge is one of the occasions for it.

The writer held this view when, as Commissioner of Bridges of New York, he took charge of the East River

bridges, nearly 20 years ago. But he found that he could do nothing in that respect during his short term of office. The Williamsburgh Bridge was building, the steel towers and anchorages were completed, the cables and its superstructure were contracted for and in process of erection. For the Manhattan Bridge the narrow tower foundations were already sunk. Such was the case also with the Queensborough Bridge. The revised designs for all these bridges were fitted to conditions that could not be changed. These designs were either mutilated or thrown away by succeeding administrations, involving a loss of many millions of dollars.

Beauty and Utilarianism — Particular effort should be made to dseign the metal towers of a large suspension bridge on artistic lines. The engineer who thinks merely of stresses must combine with the architect, who deals with artistic forms. The thousand-foot Eiffel Tower already mentioned may illustrate the point. When in a discussion with a prominent structural engineer he had pointed out to him the beautiful lines and elegant details of that great metal shaft as a fine example of French artistic skill, it was not a little surprising to hear him denounce that structure as wasteful, exhibiting poor engineering of which no American engineer would be guilty. In fact not long after, an American design, a typical shop-creation, for a very high steel tower was published as an example of what such a structure should look like. Ugliness is rational beauty to minds who see merit only in geometrical figures and in cheap fabrication. It is not unsual for an engineer to be derided by his fellow engineers as wasteful and unscientific if he uses a few extra pounds of metal or a few extra yards of masonry to make his structure more durable or more sightly. If such notions prevail, we may ask ourselves, of what effect are our boasted academies of art and schools of architecture? We have no record of any such institutions existing for the benefit of the architectural geniuses in Greece and Rome, or among the god-inspired medieval cathedral builders of Europe, or among the ancient Babylonian, Indian and Moorish architects, whose wonderful work compels our admiration to this day. We know that they did not get their inspiration from dry mathematical formulas, for they had very little of such knowledge, but they all had in them a spark of that creative supreme force and mind which molds and directs the universe and with it that innate love for the beautiful which like a flame tends always heavenward. The fine arts, which include architecture, will forever remain the true measure and index of human progress and intelligence. Future generations, wiser than ours, will judge our civilization by its achievements in monumental constructions, and for this reason we should feel it as a solemn duty and an obligation to the community to do our best in that field.

Viewed from that point, the towers of the proposed Delaware River bridge do not present a good design. They are too much on the utilitarian principle of braced telegraph poles or derricks, holding up ropes. The few architectural touches and articulations in the surface of the columns and caps are not visible from a distance and do not relieve the unpleasant impression of naked utilitarianism. The steel towers should have at least four columns to express stability and power and should have a form and bracing for which the French school of architecture, for instance, furnished fine examples of artistic treatment in the buildings of the Paris International Exhibition in 1900. From designs studied in that manner a choice could be made that would testify to the pride and good taste of opulent cities like Philadelphia and Camden, just as some of the beautiful bridges in Paris and London do for those cities.

Such towers, provided with stairways or elevators to make the top readily accessible to visitors, would require a wider base, but not necessarily a more expensive foundation, nor would they on the whole cost much more than the proposed towers. They would give the bridge its true monumental character and take it out of the commonplace. The towers should be fully designed and considered before the foundations for them are commenced. Because if the proposed narrow foundations were commenced, it would make the designing of more beautiful towers impossible. This happened in the case of the Manhattan Bridge (of which the proposed structure is an imitation), where the narrow foundations prevented a design for monumental towers and a wider bridge. This bridge, only a few years old, is already too small, so that it is used only as a one-way bridge in rush hours mornings and evenings. So is also the old Brooklyn Bridge.

As the high anchorages for the Delaware Bridge will be visible from a long distance on the river and from the shores, their silhouette and architecture should be fitted to that of the towers. That applies of course also to the suspended structure. Each has its proper share in the harmonious whole of a monumental bridge. The dominating feature however, will always be the towers.

Some Construction Details of Suspension Bridges

Wire, because of its greater tensile strength than bars or rods, found early use in suspension bridges. French engineers (Dufour in 1823 at Geneva) were the first ones to use it, while English engineers (Telford 1820) had a preference for chains of iron, in the form of forged eyebars. The difficulty found in straining the wires to uniform tension made the French engineers cautious, and so they preferred the method of construction which consisted in composing the wires into strands of parallel wires (occasionally also in the form of wire ropes). They were made on land. The strands hung side by side in vertical planes. The suspenders hung from crossbars on top of the strands and were lashed to them. This was also the construction of the first wire suspension bridge (1,100 ft. span) built over the Ohio River (1846) at Wheeling by the French engineer Ellett. The twelve strands for it were completed on land and hung on the towers. Shortly after its completion, a tornado turned the bridge upside down. John A. Roebling, who had already built a few smaller wire bridges, repaired the Wheeling Bridge. He disentangled the strands, and compacted them into two cables. Corroded wires in the anchorage were cut out and replaced. The bridge is kept in good repair and still in use, while most of the early wire bridges in France broke down from neglect and corrosion.

Roebling subsequently introduced the method of spinning the cables in the air and compacting the wires into cylindrical form by wrapping them with a continuous softer wire. This was the method followed in most American wire cable bridges. Only for two wire cable bridges over the Ohio River (at East Liverpool and Portsmouth) were the strands for the wire cables made on land.

All the early suspension bridges everywhere were built with flat catenaries, to which they owed their comparative rigidity in the absence of adequate stiffening frames to prevent undulation in the cables and chains from loads and wind. To the flat catenary (with a deflection $\frac{1}{18}$ to $\frac{1}{13}$ of the span) must also be ascribed the success of air spinning and compacting the wires under nearly uniform tension into solid cables, so that loose wires in them were rare and, in small cables, easily discovered and rectified. The last cables with flat catenaries, $\frac{1}{13}$ of the span, were those of the Brooklyn Bridge. The wires were laid up on a still flatter catenary than that of the finished cables, by moving the saddles on the stone towers toward the anchorages and thus increasing the tension in the wires during erection of the cables; this method was a great help to the better adjustment of tension in the wires before they were compacted.

The four Brooklyn Bridge cables, each 15¾ in. in diameter, were completed in 21 months. The next large cables, in the Williamsburgh Bridge, with about $\frac{1}{9}$ deflection, were finished in 7 months, and the wire cables in the Manhattan Bridge, with $\frac{1}{8}$ deflection, were finished in 4 months. The successive shorter finishing times indicate the progress made in rapidity of cable construction, but it is a moot question whether the quality of the cables, as regards evenness in tension of wires, is as good in the latter as in the Brooklyn and earlier bridges.

Many loose wires near the towers were observed during the compacting of the cables in the Williamsburgh Bridge.

and they occurred also in the Manhattan Bridge. The compacting and wrapping machines, starting from the middle and working towards the towers, compact the carefully laid wires so tightly that it would be impossible to pull out a single wire from the compacted portion only a few feet long. Loose wires can be adjusted in length only by cutting them and inserting a little turnbuckle splice, with which to tighten the spliced wires if possible to the same tension as the other wires. The trouble is, however, that with all possible care in laying the wires, each adjusted in length with the guide wire, their length is constantly changing from changing temperature conditions in open-air work, exposed to sun and winds. There always occur wires a few degrees warmer than others, producing local differences in tension and position in the same wire when in part already gripped in the compacted part of the cable. The compacted wires cannot slide on each other between the bearings on the towers, where they are held fast by their pressure. So the wires with less tension are forced together and compacted with those of higher tension. But where the wires are not yet confined and compacted, they will bulge out, particularly as the compacting machines are nearing the towers. If the tension in the parallel wires at any one section of the cable differed even as much as 25 per cent, it would mean no more than that some wires are stressed more than others, but that on the whole they are pulling together. The modulus of elasticity for the cables would of course be much lower than for the simple wires, but in the aggregate the entire cable section may have a sufficient margin of strength and safety. If the unequal tension in the wires can be controlled and kept between certain limits by careful work in the compacting of the cables, the total effective elastic strength of the cable, the only thing that counts, will be lowered, but still will be high enough to include maximum stresses from loads and temperature. But this condition can be attained by simple methods only in smaller cables, in which the loose wires can be discovered and adjusted. As the diameter of the cable and the number of wires increase, such adjustment becomes increasingly difficult if not impossible.

Manhattan Cables Near Limit

The cables in the Manhattan Bridge, 21 in. in diameter, may be considered as the limit of size for such work, and it is not at all certain that the limit for safe air work was not already then exceeded. There exist no reports on the condition of the cables, during erection, except the observation of many loose wires forced into position by the compacting machines. If large cables, before being compacted, could be uniformly loaded with a large part of the suspended load, which would produce in the wires between bearings greater tension and stretch than that due to their own weight plus the elongation from the highest summer temperature, and allowed to slide freely upon each other during their elongation, and then compacted in that condition, each wire in the cable between bearings would be under uniform tension although the many wires may differ slightly in tension one with the other. The aggregate strength of the cable would be brought nearer to the theoretical strength, which is equal to the sum of the wires. This method would require special preparation and would obviously be costly, and slow. A less effective alternative method would consist in starting the compacting machines on the empty cables from each tower down towards the center and ends, instead of the reverse, which latter is the accepted practice. The bulging of loose wires would then occur in the middle of the river span and near the anchorages instead of near the towers. Their adjustment and resplicing would occur at those parts of the cable where they have a surplus of strength and so would be less harmful. But the difficulty, if not impossibility, of reaching loose wires in the interior of a large cable would remain.

Thus, we do not lack methods and means for making large wire cables of reliable strength, if they have to be made irrespective of cost, and if we have enough faith in their durability, which is not however justified to the extent of believing them as durable as eyebar chains. The engineer should prefer that construction which for the same money is the best and affords the greatest permanence.

This leads to the subject of *maintenance of cables*. The best practice to preserve the wires against corrosion is undoubtedly galvanizing, i.e., covering them with a zinc coating. That practice was followed in the Brooklyn and Manhattan Bridges, but not in the cables for the Williamsburgh Bridge. The wires here were covered by a thick mineral oil paste expected to fill the interstices between the wires to make them water- and air-tight. That expectation was not fulfilled. Moisture condensed from the air penetrated the interior of the cables, which are enclosed in thin steel mantles. Corrosion started and repairs became necessary within a few years. Thick white lead paint filling up all hollow spaces is the best protection for that purpose.

Dangers Which May Develop

But there is nothing permanently perfect in this world. As the zinc covering of wires may in the handling of them become abraded in spots and leave bare spaces, protection cannot be absolute. Some accidental stray electrical current may find the weak spots and by electrolysis start corrosion where it cannot be known or got at. In this connection we must keep in mind that the great strength of the wire is in the outer layers of metal near the surface, which is the reason why small wires are proportionately much stronger than large wires. If the surface corrodes away, the wire breaks easily. Several French suspension wire bridges hardly twenty years old fell down, some 60 to 70 years ago, one after another, rather suddenly, because there had been neglect in painting. The outside painting of cables can of course not stop corrosion inside and hold up a bridge. We see plain fence wire after a few years literally disappear like dust, particularly in smoke-laden air. Galvanized wire will last longer, but when corrosion does get a start, the wire seems to vanish even faster than plain wire. It is so with tin roofs and tin cans.

The writer had been a strong advocate of wire cables for large suspension bridges for many years. They appeared to be an ideal method of construction for very long spans at lower cost than other bridge types. But when on closer study and observation he discovered the practical difficulties arising from greater span and larger size of parallel wire cables, he came to the same conclusion as other observing engineers, among them the late Geo. S. Morison, certainly a high authority. In his paper, (A. S. C. E., Vol. XXXVI, 1896) on a study for a large suspension bridge, Mr. Morison had chosen for his 30-in. cables coiled wire strands, finished in the shops to accurate length and submitted to a proof-stress before erection, as preferable to cables with parallel wires.

The writer had about the same time examined into the practicability of fabricating wire links, (to be enclosed in a roomy shell of noncorrodible metal), with which to compose chains for suspension bridges. His first design for a suspension bridge at Quebec (1899) included that construction. The links were to be made of rectangular wire with corners rounded off, each link submitted to a proof stress. They were guaranteed as to strength and quality under rigid specifications by the large wire firm of Felten & Guilleaume of Cologne. There would have been absolute certainty as to the strength of chains of this construction. This same firm as well as other firms manufacture several forms of patented coiled wire cables, which have been used in suspension bridges of moderate spans with great success. These were at first proposed also for the new Budapest suspension bridge in 1894. But the engineers for that bridge decided finally, after long deliberation, in favor of chains of eyebars cut out of wide plates. There are no plants in Europe for making forged eyebars. The finer architectural appearance of huge eyebar chains and their greater durability were the final deciding factors.

The questionable condition and apparent uncertainty of strength of the large wire cables in the Williamsburgh Bridge induced the writer, as Commissioner of Bridges for the city of New York, to avoid large wire cables in the plans for the Manhattan Bridge. The design provided, therefore, for chains of forged eyebars of nickel steel,

which appeared to have many advantages over chains of wire links. That design was submitted to a board of five eminent bridge engineers and approved by them. Their report has been published (Trans. A. S. C. E., Vol. LV, 1905, pp. 89-93, Report by Geo. S. Morison, C. C. Schneider, Mansfield Merriman, Henry W. Hodge, Theodore Cooper). In comparing chains and wire cables their first report to Mayor Seth Low set forth:

The chains have decided advantages in the accessibility of all parts for inspection and protection as well as in economy and rapidity of erection. They are to be preferred to wire cables whenever the cost of chains is not materially greater. The cost of eyebar chains and wire cables in this bridge would be about the same.

In their final report they said,

We deferred our final report, relating to the quality of the material to be used for the eyebar cables, until additional tests could be had and we should be satisfied, by correspondence with the leading manufacturers of structural steel, that the desired material could be obtained at reasonable price and in open competition. In our preliminary report, March 9, (1903), we reported favorably on all features relating to the design of this bridge, subject only to the uncertainty of obtaining this quality of material. This uncertainty is now removed. In this final report, we unanimously recommend the adoption and execution of the proposed design of the Manhattan Bridge, as submitted to us by the Commissioner of Bridges.

The reason why the Manhattan Bridge was not built on the approved plans is well known. Before the contracts could be let, another city administration was elected, which also changed the management of the Bridge Department. The approved plans were thrown away, and new plans were made for a wire cable bridge, costing several million dollars more than the chain bridge. No board of engineers was called into report on these new plans, or compare them with those already approved. The character of bridge management can be judged from the fact that the courts were appealed to by outwitted bidders to stop fraud in awarding contracts on manipulated bridge specifications. That a management of this kind would be very much concerned about the quality of the work or about progress in the art of bridge building was not to be expected and it is for this reason that we are without reliable scientific information or records on many details of erection and maintenance of the East River Bridges of that period. Among these are the actual condition of the big wire cables, erected in the unprecedented short time of 4 months, a very creditable performance, provided it was not at the cost of quality.

30-In. Wire Cables Big Advance

In any event, there is no reliable basis or safe precedent for a leap from 20-in. cables to 30-in. cables with parallel wires, as now proposed for the Delaware River bridge. It would be a great achievement, most desirable also from the architectural point of view, to have big wire cables. In the writer's studies for the North River bridge they would have been 60 in. in diameter. But it is one thing to design them and another thing to be assured of their safe obtainment.

That there are large secondary stresses in large stiff wire cables is now better understood than when the East River bridges were built, where they were not considered. The largest stresses from tension and bending occur at the towers, just in that part of the cable liable to have the most wire splices from adjustment of wires. Safe provision can of course be made for secondary stresses by increasing the cable section and leaving 150 to 200 ft. of cable at the towers uncompacted, so that the wires can slide on each other for that length to prevent excessive stresses from the bending of the cables. All this can be done, but it adds to weight and cost of cables and is poor construction.

In chains of eyebars no uncertainties of stresses can occur, as all determination of length and all fitting are done in the shops with great accuracy, which must be one of the determining elements in any great metal bridge. This feature was well considered in the design made for the Pennsylvania Steel Co. for an eyebar suspension railroad structure at Quebec in 1910. In *Engineering News* of Nov. 23, 1911, the comparison of weight is given with the official equivalent cantilever design. The competition in this case did not decide the merit of any competing designs, as the contract was awarded to a cantilever structure not complying with specifications and therefore 30 per cent lighter than any other design, including the so-called official design. The length of the river span (1,756 ft.) in this design was practically the same as in the proposed Delware Bridge (1,750 ft.), so that the two are readily comparable when transposed to the different load conditions and the higher unit stresses would would be justified with the present higher steels.

In this connection the report above mentioned on the chain design for the Manhattan Bridge, a carefully considered judgment from engineers of great experience and high attainments, is worth thoughtful consideration. The cost of eyebar chains and wire cables is mentioned as being about the same (in 1903). The comparison was based on nickel-steel eyebars with 48,000 lb. elastic limit and 85,000 lb. ultimate strength. That was also the basis for the chain design for the Quebec Bridge, 12 years ago. But since then progress has been made in the metallurgy of steel, and large eyebars can be obtained of high steel with elastic limit and ultimate exceeding 80,000 and 110,000 lb. respectively. With such material an eyebar suspension bridge cannot help but be superior in quality to a wire cable design, and also cheaper in total cost, when properly designed. It is surprising that improvements in the art are ignored and that no studies for chain designs have been made by which the merit and economy of the proposed wire cable bridge could be tested. That could probably be best done by a competition of designs, but not of the kind had on the Quebec Bridge.

Studies for a large bridge cannot be considered complete until every phase of it has been examined in the light of progressive scientific knowledge. But in all or any designs for a large city bridge, architectural considerations should prevail, for the reasons already stated. That much its builders owe to the public and our age.

Railway Electrification in England

REGULATIONS recommended to the British ministry of transport in the final report of the technical committee on electrification of railways, in order to promote standard practice, provide for a direct-current system of 1,500 volts, but permit higher voltage in multiples of the standard pressure and also 750 volts where sufficient advantage can be shown. Continuance of existing 600-and 1,200-volt systems is approved, however, mainly for the reason that the London, Brighton & South Coast Ry. long ago adopted a single-phase alternating-current system for its suburban lines and is intending to extend this system on its 50-mile main line to Brighton.

Both overhead and third-rail collecting systems are permitted. For third-rail conductors either the top or bottom contact system may be used, but the latter is considered to have advantages in regard to snow and ice accumulation and to protection of men working on the track. In either case, the contact rail is to have its center line 16 in. from the gage side of the track rail, the contact surface being 3 in. or 1½ in. above the track rail for top and bottom contact rails respectively. Where overhead conductors are used, the distance between the conductor and the clearance line of equipment is to be 36 in. on the open line and 10 in. in tunnels; at grade crossings the conductor must be 18 ft. above the rails, and at points where men may have to work on top of the cars the height must be 20 ft. Overhead conductors must be 21 in. from the center line of track at 4 in. above the equipment clearance line, and 15 in. at a height of 18 ft. above rail level.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Improving the Terminology of Mechanics

Sir—I offer a few suggestions respecting the nomenclature and notation of mechanics, or dynamics, as it has been designated in recent years.

It is quite generally known that *dynamics* is the science which treats of the action of forces upon bodies and that it is subdivided into statics and kinetics, *statics* applying to bodies in equilibrium and *kinetics* to those in motion. The older term *mechanics*, according to modern usage, should apply exclusively to the structures of transmission of force, whether these be machines and other mechanisms, trusses, or matter structures. The expression *dynamic loading* should be superseded by *kinetic loading*, since the Greek root for kinetic signifies to move, whereas dynamic applies equally well to conditions of rest or motion.

The best definition for stress was once given by Professor I. P. Church—distributed force. It is force per unit of area. The expressions *unit stress* and *total stress*, literally signifying unit-unit and total-unit, should be superseded by the terms *stress* and *force* or *traction* respectively, or their equivalents, the term traction being already used in dynamics for the latter purpose. A pressure is a negative traction.

The term *strain* is a unit and had best replace such redundant expressions as unit deformation, deformation in inches per inch, unit elongation, unit shearing distortion and the like.

Ultimate stress should be understood to mean the last recorded stress applied during a test. It should not be confounded with the expression *maximum stress*, which should be used in its strict mathematical sense as "peak of the load" or greatest.

The expressions *bending stress* and *torsion stress* should be replaced by *bending couple* and *twisting couple* or *torque*, as, strictly, there are no such stresses. Works, torques and bending moments should be stated as pounds-inches, etc., instead of the reverse, as the idea of force by distance is fundamental.

There is no scientific basis for the use of such terms as *true* and *apparent stresses*. A lateral stress is not induced when a bar is stretched in the direction of its axis and this cannot be shown analytically or by tests. It would therefore seem advisable to omit a consideration of these "stresses" in texts and engineering pocket books, as they are not recognized in the standard dynamical treatises and are generally misleading to young engineers and students.

It would seem advisable to introduce into engineering texts the modern notations and methods of combining stresses and strains as given in dynamics, abandoning the notations and methods based on the older authorities, Rankine, Lamé, and Townsend, which have outlived their usefulness. An engineer using the strict dynamical methods of obtaining principal stresses, combined stresses and resultants can solve his problems more effectively than by the older methods, which are cumbersome. Again, where the particular ellipse-of-stress method of Rankine is used considerable time is required in reducing the problem and its conceptions to paper. The standard dynamical method is easier and more expeditious, in that it can be worked out quickly by slide rule.

As regards notations for stress and strain, Kirchhoff's is to be preferred. It conveys at a glance the meaning of each symbol, one may say automatically, in a somewhat analogous way as is done by the well-known notation of Bow in graphical analysis of structures. Capital letters corresponding to the co-ordinate directions suffice for the stresses, while subscripts to these letters indicate the planes on which the stresses act. The terms X_x, Y_y, and Z_z, for example, indicate stresses pointing in the respective co-ordinate directions on planes perpendicular to these directions. The term Y_z is the stress acting in the direction of y on a plane whose normal points in the z direction, and so on. The corresponding strains are indicated similarly, but with a lower-case letter and subscript. A further desideratum exists in the fact that cyclic symmetry prevails throughout in equations for stress, this symmetry being absent in the engineering notations. It renders formulas of more general utility and easier to memorize.

J. H. GRIFFITH,
Professor of Experimental Engineering, Iowa State College.

Ames, Iowa,
Oct. 29.

Detecting Flash Setting Cements

Sir—We have read the article in your Oct. 27 issue by C. L. Jenkin on the setting time of cement with appreciative interest as it touches on a feature of the testing and use of cement which we think deserves far more serious attention than it usually receives.

In our cement testing department we have frequently noted the conditions described by Mr. Jenkin and have come to the conclusion that some cements have a latent tendency to flash setting which is difficult to detect by the conventional test for setting time. We tried various means of revealing a tendency to flash setting which the cement test did not disclose and found three methods which apparently were of equal effectiveness. We sometimes heated the cement and water to 100 deg. F. while on other occasions a cement that was under suspicion would be exposed to the air in a thin layer for 24 hours. The third expedient consisted in allowing the cement, after adding the water for the setting time determination, to remain undisturbed for five minutes before mixing into a paste. If a tendency to flash setting exists in cement it is usually impossible to mix it to a paste if allowed to stand for five minutes after adding the water. The two methods first mentioned are frequently effective in so exaggerating the tendency to flash setting as to make it clearly apparent by the cement test.

Curious beliefs spring up in the trade concerning cements. On a recent day we heard a certain brand of cement bitterly criticised by one contractor for slowness in hardening and by another contractor for setting so quickly as to present difficulty in getting the concrete into the forms before setting occurred. This apparent inconsistency is probably due to the fact that the cement in question almost always tends to become flash setting or else has the ability to develop what might be termed a false initial set. The slow hardening complaint was probably due to the fact that the set was broken during the mixing with resultant slow hardening while the party who found that it hardened too quickly was probably mixing too short a time to break the set so that setting commenced in the buggies and chutes.

While for many purposes the presence of a flash setting tendency in cement may be ignored, it is of vital importance that cement for concrete floors, sidewalks, roads and many other uses be normal as to setting time.

E. L. CONWELL,
President, E. L. Conwell & Co., Inc.

Philadelphia, Pa.
November 1.

Stresses in Eyebar Heads

Sir—I have read with interest Josef Beke's article "A Study of Stresses in Eyebar Heads" in your issue of Aug. 11, p. 234. However, the formulas for X_o and M_o, which I have checked by an independent derivation, impress me as too theoretical, by which I mean that the assumptions on which they are based do not cover important points of the existing conditions with sufficient approximation, so that the finely worked-out formula after all gives only a rough approximation.

The eyebar head is not a ring, as the body of the bar is continuous with the head and restrains the deflections and angular deviations of the head. The actual stress in the head must lie somewhere between the stress in a ring as computed by Mr. Beke and the stress in a bar with the body as wide as the head. By taking 50 per cent of each stress and adding them together the result must be nearer the correct value. It is questionable, also,

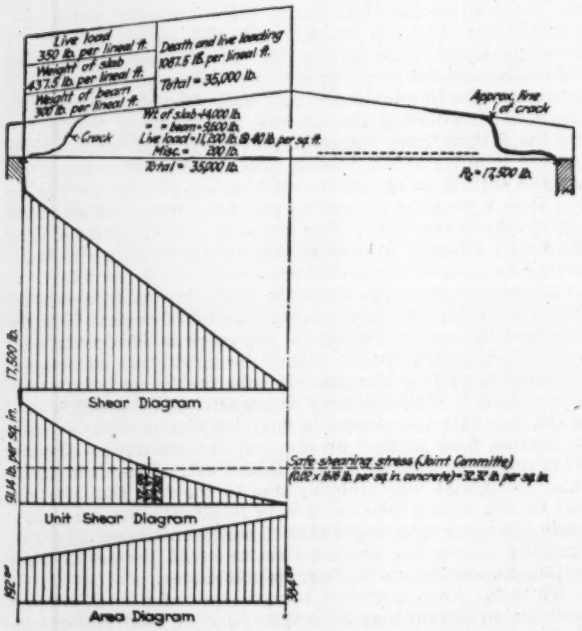
whether radial plane sections will remain plane; I believe that the transfer of the direct stress from the bar to the head does not take place on the middle line of the head but is crowded nearer to the pin hole.

However, I believe that a value for the tension at the inner edge on a transverse diameter, $S_x = 2.5T$, where T is the unit stress in the body of the bar, is approximately correct. By a much simpler method I have arrived at a value for S_x equal to 2.4T. I do not give this method as it is nothing but an application of the moment area method to a fixed beam. It is with this as with Euler's formula where the assumption of an ideal column (a thing never found) necessitates the use of higher mathematics, while an approximate method gives the same result with a difference of a few per cent. C. L. CHRISTENSEN.

Detroit, Oct. 25.

Another Concrete Failure Due to Poor Design

Sir—We are continually hearing of failures in concrete structures due to what "after the accident investigators" call "poor design," or a design fundamentally inadequate in strength, but the real reason may be more truly stated to be either ignorance or gross negligence on the part of the designer.


Live load 350 lb. per lineal ft.
Weight of slab 437.5 lb. per lineal ft.
Weight of beam 300 lb. per lineal ft.
Dead and live loading 1087.5 lb. per lineal ft.
Total = 35,000 lb.
Approx. line of crack
Crack
Wt. of slab = 14,000 lb.
" " beam = 9,600 lb.
Live load = 11,200 lb. @ 40 lb. per sq. ft.
Misc. = 200 lb.
Total = 35,000 lb.
R2 = 17,500 lb.
17,500 lb.
Shear Diagram
Safe shearing stress (Joint Committee)
Unit Shear Diagram
Area Diagram

REINFORCED-CONCRETE ROOF GIRDER WITH NO SHEAR REINFORCEMENT—IT FAILED

I am showing herewith another glaring example of what we may call, for politeness sake, "poor design" made by a firm of industrial engineers in New York City. On the drawing is shown one of the typical roof beams which failed. This beam was built to support the roof of a pump house and the lines of failure are as shown on each side of the beam. These beams were spaced 8 ft. 9 in. c. to c. The length of beam was 32 ft. The height of beam varies from 2 ft. to 4 ft. high by 8 in. wide. The steel allowed was two 1¼-in. longitudinal straight bars, placed at a distance of 5 in. up from the bottom of beam. This was to carry a total loading of 35,000 lb. Under the sketch is shown a table, a shear diagram, an area diagram, and also a unit-shear diagram. And it will be noted that from stresses due to moment the steel is being asked to take 21,400 lb. per square inch with the concrete at 975 lb. per square inch. This is excessive, and good engineering practice would have called for stirrups or other web reinforcing where the shear exceeds 32 lb. as shown in the sketch.

Is it not therefore to be wondered, in viewing the above from the designer's point of view, why these beams did not fail long ago? The beam was poured monolithically with the concrete side walls, and there was therefore a tendency for cantilever action, and further, the tops of the beams at the ends were in tension with a negative bending moment, as is the case in continuous beams. The steel was placed at a distance of 5 in. above the bottom of the beam, which is too great for good engineering practice. Only enough covering is required to ensure bond and fire protection, which is surely not as much as 5 in.

The high shear and diagonal tension stresses which set up in this beam near the ends were not properly taken care of by shear reinforcement and we have therefore failure in the beams along lines of structural weakness as the natural and logical result. HERBERT CANTWELL.

Espanola, Ont., Oct. 26.

Locomotives and Railway Bridge Strength In China

Sir—P. H. Chen's article on the relative impact from American versus European locomotives, in *Engineering News-Record* of July 14, p. 58, has caused much comment both here in China and in America; over here offering an opportunity to deliver encomiums on American locomotives and hurl abuse at European bridges, without much endeavor to analyze the matter.

Certain observations simplify the matter somewhat. Since the impact from American locomotives was brought under suspicion, many have insisted on imputing the rather large difference in weight between American and European bridges to provision for such impact. As a matter of fact the difference is largely accounted for on other grounds, the American designs providing for greater permissible overloading, and for less rapid wearing out of the structures. The American bridges could undoubtedly be made lighter and hold up their loads, but usually the regret is that they were not made even heavier on account of unexpected load increases.

The problem has been discussed from the too narrow viewpoint of the bridge engineer over here. Of course the question of locomotive design was bound to be injected into the discussion, but the effect of locomotives on bridges (all-important in bridge design) counts for but little in the broad considerations involved in selecting locomotive types. By exaggerating the place of bridges in a railway system we have attempted to rate the excellence of locomotive according to their effect on bridges. Now, locomotives are not designed simply to provide loads for bridges, but bridges are designed to carry locomotives, and to carry such locomotives as are necessary to handle the traffic economically. If the American locomotive types are the best to carry the traffic, then the bridges must be designed to carry them, and if China's traffic conditions are coming to resemble America's, and if China wants American motive-power efficiency (the few American locomotives in use here are more than proving their work), then China should adopt American locomotives with the bridges they entail, and not complain of a few extra pounds of steel, if necessary, especially since they provide for a reasonable overloading, which may prove of great value under unexpected increases in traffic.

The tests made, aside from their insufficient number to draw any conclusions from, may be questioned as to their validity, as other factors besides locomotive weight must be considered before we can make any general statements about excessive impact; for example, the operating speed designed for, extra strength in reciprocating parts to permit of being operated at maximum capacity all the time and minimize repairs (requiring different counterbalancing), requirements that necessarily and justifiably give one locomotive greater impact than another of about equal weight.

One fact probably may be revealed, namely, that American locomotive builders are looking into Chinese operating requirements less carefully than the Eureopean firms, for example, in regard to providing extra strength so that it will be permissible to shift crews on the locomotive as necessary in America, while in China one crew stays with a locomotive and takes pride in its upkeep.

On account of the great effect of the period of vibration

of the structure and of different kinds of piers on impact, valid comparisons cannot be made between experiments made in Europe and those made in America. The same bridges ought to be used for all the kinds of locomotives tested, and here in China there is abundant opportunity for looking into the matter. The tests should be continued not so much to see whether American or European locomotives produce the greater impact, which is after all a less important matter (as locomotives are selected on broader economic considerations) but to decide whether the European type of bridges now used on many lines can longer be tolerated on the Chinese railroads.

Tientsin, China, Oct. 12. JOSEPH H. EHLERS,
Professor of Structural Engineering,
Pei Yang University.

Figuring Stresses in Concrete Chimneys

Sir—In the article in your issue of Sept. 29, p. 512, entitled "Short Cut Design of Concrete Chimneys," the method of determining the vertical steel required in a concrete chimney by designing a steel chimney is in error. The vertical tension in any chimney is due to the wind pressure less the weight of the chimney. It is quite apparent that the weight of a concrete chimney is much greater than that of a steel chimney, and the net tension is therefore much less.

In regard to the foundation, the center of gravity of the pressure diagram is of course at the point of application of the resultant. The pressure diagram extends from the edge of the base nearer to the resultant to some point determined by the shape of the base. In a square base with the wind pressure parallel to two sides, this point is three times the distances of the resultant from the nearer edge, provided of course, the diagram does not extend past the further edge of the base. There cannot be any tension on the soil whether the diagram extends entirely over the base or not. In the case of small steel stacks, the pressure diagram very rarely extends entirely over the base.

The problem of finding the pressure diagram is very simple in the case of a square base with two sides parallel to the wind pressure. It is much more complicated with an octagonal base. It may be found, however, by the prismoidal formula, and a formula derived which makes calculations simple. The object of finding the pressure diagram is of course to determine the maximum soil pressure on the leeward side, which is the critical point of the design. J. T. N. HOYT.

Roof-Shield Work and the East Boston Tunnel

Sir—The article of W. C. Briggs, "Timbered and Roof-Shield Tunneling in Deep Loose-Ground Subway Section," published in *Engineering News-Record*, Oct. 27, p. 676, describes the construction of a section of Brooklyn subway by means of a roof-shield. It is claimed the roof-shield was unique because of the fact that the shield was shoved directly after placing of a ring of concrete, the shield jacks depending for their reaction upon push-rods embedded in continuous lines in the concrete of the tunnel shell. Mr. Briggs adds that so far as the author is aware the combination of a shield, concrete forms and wet concrete immediately behind the shield had never before been used.

It seems to me that the same method has been used in the construction of some sections of the Boston subway, described in the reports of the Boston Transit Commission, Howard A. Carson, chief engineer, and also in *Engineering Record*, Feb. 26, 1898. The same method was exclusively employed in the construction of the East Boston tunnel, the description of which is found in the reports of Boston Transit Commission for the years 1901 and 1902, in *Engineering Record*, March 23, 1901, in *Engineering News*, Jan. 23, 1902, and illustrated by myself in *Traction and Transmission* (London), in March, 1902.

New York, Oct. 28. CHARLES PRELINI.

(Mr. Briggs' reply to the above comment follows.—EDITOR.)

Sir—In reply to Mr. Prelini I have to say that apparently he is in error in his reference to the Boston Tunnel described in *Engineering Record*, Feb. 26, 1898. which has a brick arch lining instead of concrete. His other reference, however, is correct, so much so, in fact, that as soon as I examined it, I was convinced that the Brooklyn construction was copied from it. In following the matter up, I learned (as I had already guessed) that Robert A. Shailer, consulting engineer, Boston, Mass., who has always been thoroughly conversant with Boston tunnel construction and has been identified with some of it, recommended the shield plan, about as adopted, to the Degnon Contracting Co.

Except for making up an independent proposal in 1916 for the Brooklyn work described, I had no connection with it whatever until after my predecessor had left it; consequently, I knew one of the details relative to the adoption of the shield method. In connection with the proposal referred to, I had a library search made covering certain types of tunnel construction; it just happens that the particular Boston tunnel section referred to by Mr. Prelini was not mentioned in the search, although other sections of the Boston tunnel were.

It pleases me to have the error corrected and I am thankful to Mr. Prelini for his interest in the matter.

Brooklyn, Nov. 14. WALDO C. BRIGGS.

In Defense of the Engineer

Sir—The extract of Mr. Cabot's speech headed "The Engineer a Failure as a Manager," in *Engineering News-Record*, Oct. 27, p. 692, certainly requires rebuttal. Not that Mr. Cabot's opinion (which he states as an accepted fact) is generally held either in or out of the profession so far as I can determine, but merely on the ground that a statement, no matter how erroneous, will gain credence from unchallenged repetition.

At the outset we must admit that if to have one's feet on the solid ground, to know and weigh the obstacles to be overcome, to not fail in the critical hour, be faults, then the engineer is damned. But with Mr. Cabot's major premise that the engineer is born without imagination and has his idealism throttled in infancy we do take issue. No aesthete can be crassly material nor devoid of imagination.

True it is that the engineer of fifty finds his enthusiasm of the twenties somewhat damped, his idealism somewhat dazed by the glare of a commercialized world, and his imagination perhaps dulled by the necessity of keeping his nose to the grindstone. So also does the lawyer, the manufacturer, the statesman and the hod-carrier. I have never heard a banker accused of having either enthusiasm or imagination, so cannot say if this applies to them. In citing instances to justify his conclusions Mr. Cabot begs the question by admitting that the banker "yearning for a sure thing," picked the engineer. The inference that in such selection the qualities under discussion would be a bar is inescapable. Though the profession lays no claim to a monopoly of imagination and idealism it would probably be rank heresy to suggest that the banker was in any wise to blame for a poor selection from a good field.

For the rest Mr. Cabot's argument appears to be a disjointed attempt to saddle the blame for the failure of sundry trusts onto the profession though no engineers were connected with them; and to hold the railways up as a horrible example when, by his own admission, the politicians and bankers are responsible for their condition insofar as it is not attributable to economic conditions brought on in part by these same trusts.

The statement that the engineer's "natural position is that of the hand which executes rather than the mind that conceives. Leadership is not native to him," is a bald slur which is probably father to the wish and needs only to be stated alone to fall of it's own weight.

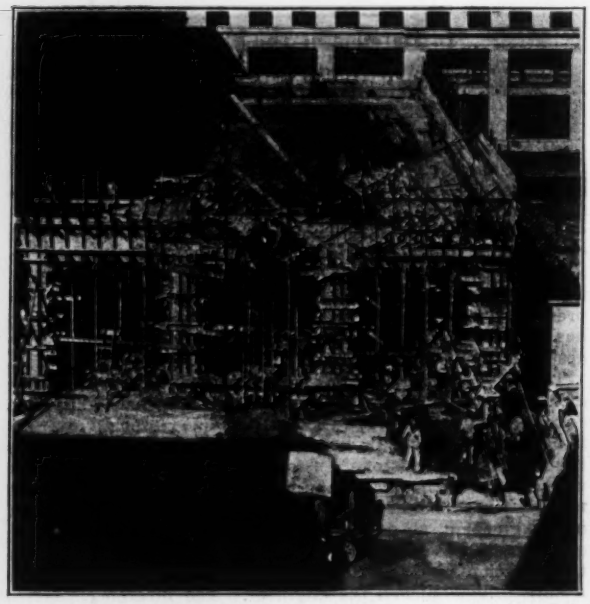
In short, Mr. Cabot's complaint in so far as it can be analyzed boils down to this: The banker entrusted his enterprises to engineers carefully selected for lack of imagination and their readiness to "take orders," and now, dissatisfied with the result, tries to indict the profession for his own fault. C. E. MUHS.

Chicago, Ill., Nov. 5.

HINTS FOR THE CONTRACTOR

Motor Truck Supplants Concrete Buggy Hoist on Small Job

ON JOBS in which a comparatively small amount of concrete has to be elevated, particularly in the construction of one-story buildings, Barrett & Hilp, contractors of San Francisco, Cal., have several times found it economical to use a light motor truck instead of bringing a motor driven hoist to the job. The truck is usually operated up and down on the street in front of the work. By means of a single line running from the truck through snatch blocks on the ground and over a sheave above the landing platform, as the truck moves backward and forward it raises batches of concrete or lowers empty containers.



MOTOR TRUCK REPLACING HOIST ON SMALL JOB

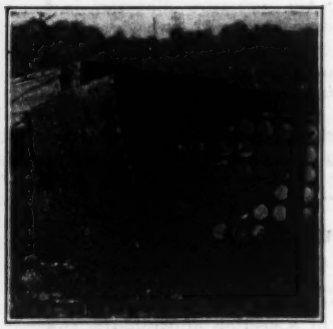
In the accompanying picture this plan is shown in operation on a building where concrete was raised in hand buggies about 18 ft. above street level. On this job it was possible to locate the truck runway so that the driver would at all times face his work. The support for the hoisting sheave here consisted of two uprights (each made of two 2 x 6-in. timbers spiked together) placed vertically 8 ft. apart, and set so the cross tie between them overhung the face of the building by about 30 in. The cross tie was placed high enough so it would handle concrete to be delivered by gravity into the top of the parapet wall. These uprights require guy wires to insure stability.

With this arrangement 90 cu.yd. of concrete was hoisted per 8-hour day, using the regulation 6-cu.ft. concrete hand buggies and a mixer whose charge would provide the proper load for two buggies. The buggies had ½-in. iron bars welded diagonally across their tops for convenience in attaching the hook by which they were hoisted. On this job the buggies were handled at the rate of 36 seconds per round trip, i.e., one full buggy hoisted and one empty buggy lowered. This rate of delivering material was maintained with a crew of six or seven men and the truck driver, distributed as follows: two men landing buckets on the upper level, two buggy men on the ground between mixer and hoist and two buggy men on the upper level delivering to forms. Three buggy men were required on the upper level when the forms to be filled were well away from the hoist.

With the arrangement as shown in the picture, if the attendant on the ground is careless or lazy the descending empty buggy is likely to strike a full buggy which is standing in position ready for hoisting. Danger of breakage due to this cause would be lessened, it has been pointed out, by the use of a runway hung alongside the hoist frame on a horizontal axle and set so the top of the runway could be tilted out under the descending buggy, deflecting it to one side, preferably toward the mixer. By attaching a counterweight on the bottom of such a runway, it would automatically return to vertical position when released, thus leaving no obstruction in the way of the ascending buggy.

Rockskip Made From Boiler

A UNIQUE piece of equipment for handling rock is being used by the Hugh Nawn Contracting Company on the Gilboa dam, New York. It is a rock skip, illustrated in the accompanying photograph, and made of a vertical tubular boiler. The boiler shell was cut in half, a new iron strip was bolted to the inside of the tube head at the top, and another strip with a hook, at each end. The whole formed a skip for handling rock hoisted either by derricks or by cableways.



IMPROVISED ROCK SKIP

The information contained herein was furnished by Theodore Hanan, Flory Manufacturing Co., Bangor, Pa.

Bituminous Filler for Granite Block

Asphalt mastic filler for granite block pavement has proved so satisfactory, states C. D. Pollock, consulting engineer, New York City, in a paper presented at the City Paving Conference in Philadelphia, Pa., Oct. 20-21, 1921, that the crude methods of use which now prevail should be eliminated. The present hand mixing methods are inexact. Mechanical mixing is an improvement, but of measuring the materials in order that the amount of sand used shall be uniform. It is also desirable that tests be made to determine more accurately the proper amount of sand to use. This amount should be as great as possible and still permit the mixture to flow readily into the joints.

NEWS OF THE WEEK

New York, November 24, 1921

Jubilee of American Public Health Association

Founder Present and Honored—Sanitary Engineering Section Meets With Am. Soc. C. E.

The semi-centennial celebration of the American Public Health Association was held in New York City, Nov. 14-18. Coincident with this meeting was the Health Exhibition and preceding it by a week was the Public Health Institute, both previously announced in these columns. The institute, which was largely attended, consisted of demonstrations of many and various lines of public health activity and of sanitary engineering works in New York City and vicinity.

A unique feature of the convention was the presence of Dr. Stephen Smith, one of the founders and the first president of the association, who is now in his ninety-ninth year, as noted in a biographical sketch elsewhere in these columns.

As has been customary, the association, as a whole, met in a few general sessions, but the vast mass of work was done through numerous section meetings—sanitary engineering, laboratory, vital statistics, public health administration, sociological, industrial bygiene, food and drugs, child hygiene, and health education and publicity.

Two Main Features

Features of the two main general sessions were (1) reviews of public health history during the last fifty years, in which sanitary engineering was presented by George W. Fuller, consulting engineer, New York City; quarantine, by Hugh S. Cumming, Surgeon-General, U. S. Public Health Service; bacteriology, by Edwin O. Jordan, professor of hygiene and bacteriology, University of Chicago; and public health work in Cuba, Mexico and Canada, by representatives of those countries. (2) An address on "European Health Conditions" by Prof. C. E. A. Winslow of Yale University.

Among the many business items affecting the whole association of chief interest were the announcement of the choice for new president of Dr. A. J. McLaughlin, of the U. S. Public Health Service, Washington, D. C.; the selection of Cleveland, Ohio, as the next meeting place; and a revision of the constitution of the association.

Sanitary Section Officers

The officers for the ensuing year chosen by the Sanitary Engineering Section include W. H. Dittoe, chief engineer, Ohio State Department of Health, as chairman; C. A. Emerson, Jr., engineer, Pennsylvania State Department of Health, vice-chairman; E. B. Rich, engineer, State Board of Health, Lansing, Mich., secretary (re-elected); and Theodore Horton, chief, Sanitary Engineering Bureau, Office of State Engineer, Albany, N. Y., section representative on the board of directors of the association.

(Continued on p. 870)

California to Offer Road Bond Issue of $7,000,000 At Once

The California state highway finance board has announced that $7,000,000 worth of state highway bonds will be offered for sale at Sacramento, Cal., Dec. 22. Because of the high premium commanded by the $5,000,000 block recently sold, as reported elsewhere, the interest on the new issue will be only 5 per cent. The proceeds of this sale will be used as part of the 1922 construction program which is expected to amount to a total of $18,500,000.

Rejects Commission-Manager Plan at Lockport, N. Y.

The commission-manager plan was defeated at Lockport, N. Y., Nov. 8, by a popular vote of 2,662 to 2,325, this being the third adverse vote.

Buffalo Votes for Water Filters

Buffalo, N. Y., on Nov. 8, voted 39,381 to 26,509 for a water filtration plant "at an estimated cost of $4,000,000, not to exceed $4,500,000." The plant will have a capacity of 160 m.g.d. and will be located near the Francis G. Ward pumping station. It will probably be six or eight months before plans will be ready for bidders. George C. Andrews is water commissioner and Arthur W. Kreinheider is commissioner of public works.

To Relieve New York Transit Jam By Staggered Work Hours

Following a report by Daniel L. Turner, its consulting engineer, the New York Transit Commission last week announced a plan of relieving traffic congestion on the city's rapid transit lines during the rush hours by urging employers to adopt a "staggered" schedule of opening and closing hours for their stores and offices. A classification of industries is to be made.

Summarizing the need of facilities sufficient to increase the capacity of the transit lines 60 per cent, Mr. Turner says:

"Contracts covering all of the city-owned rapid transit lines in operation have cost the city and companies together to produce to date approximately $454,000,000. Sixty per cent of this is $272,000,000. A large portion of these facilities were constructed under pre-war prices. To reproduce them now would probably cost at least $500,000,000. Therefore, spreading the traffic peak evenly over two hours, morning and night, would in this sense increase the capacity of the existing facilities as much as new facilities costing perhaps from $200,000,000 to $300,000,000 would represent."

But Mr. Turner says that a 40-per cent increase in capacity would be sufficient to meet a 5-year traffic increase.

Agree on Variety Limits for Paving Brick

Eleven Varieties Out of Sixty-six Believed Ample for Most Needs, Manufacturers' Report Shows

Responding to an invitation of the Department of Commerce, representatives of paving brick manufacturers and engineering societies met in Washington Nov. 15 and agreed upon limiting the number of varieties of paving brick to 11. These 11 standard varieties are to be presented for approval to the organizations represented. The conference agreed on the formation of a permanent committee, with its executive member in the Department of Commerce, to which will be entrusted the duty of following up the action taken at the meeting and also of furnishing machinery whereby questions of further simplification may be considered.

Among the organizations represented were the National Paving Brick Manufacturers Association, the American Society of Civil Engineers (by Col. W. D. Uhler), the American Society for Testing Materials (by W. E. Emley), the American Society for Municipal Improvements (by George F. Fish), the American Association of State Highway Officials (by Leon C. Herrick), Western Society of Engineers (by John A. Dailey), a number of government bureaus, and half a dozen other engineering societies.

Report Gives Facts

An excellent survey of current varieties of paving brick made by the secretary of the paving brick association, M. B. Greenough, formed the groundwork of the meeting. The survey disclosed 66 current varieties. A summary of the more important facts disclosed is printed elsewhere in this issue.

In the plain wire-cut class 92½ per cent of all shipments this year was in two sizes—4 x 3 x 8½ in. and 4 x 3½ x 8½ in. The other 7½ per cent of the shipments was in the remaining six varieties. In the repressed lug class 79½ per cent was in the 3½ x 4 x 8½-in. variety, and 20½ per cent in the 22 other varieties. Shipments were also strong in the 3 x 4 x 8½-in. and the 3½ x 3½ x 8½-in. varieties.

In the other classes of brick the sharp demarcations shown in the class already referred to did not obtain.

In preliminary deliberations in the full conference the elimination of 46 varieties was agreed upon. These went out as a result of resolutions eliminating all brick which were less than 3 or more than 4 in. in depth, less than 3 in. in width, and which were not 8½ in. in length. The matter of further eliminations were then referred to a committee with instructions to report at the afternoon session.

The committee's report eliminated 9 varieties in addition to those which had been eliminated in the full conference. The committee stated that it had

approached the subject with the desire of eliminating all sizes except those which could be cut from a 3-in. or a 4-in. clay column. On discussion, however, it was apparent that engineering practice is running rather strongly in the direction of using a brick 3½ in. deep, and the committee therefore concluded that brick of a 3½-in. depth would have to be provided for. State highway departments, for example, while finding that a 3-in. brick is too light for their use, find it unnecessary to go to the 4-in. depth which city paving practice demands.

In recommending the elimination of a 3 x 4 x 8½-in. repressed lug brick, the committee explained that while 5,000,000 of this brick were shipped this year, up to Aug. 1, its elimination was recommended because no hardship was imposed by asking users of this brick henceforth to substitute the 3½ x 4 x 8½-in. brick instead. No saving in freight is made by the use of the smaller size, which is identical in depth but is ¼ in. narrower than one of the standards approved.

The committee recommended that all special brick, with two exceptions, be non-standard. The exceptions are one standard size in the Dunn hillside brick and one in the repressed hillside brick.

Eliminations

Before discussing the varieties in detail the conference unanimously adopted a resolution to the effect that reduction in number of varieties was in the interest of both consumer and manufacturer.

The sizes recommended for adoption by the committee and approved by the conference are as follows:

Plain wire-cut (vertical fiber lugless): 3 x 4 x 8½ in., 3½ x 4 x 8½ in.

Repressed lug: 3½ x 3½ x 8½ in., 3½ x 4 x 8½ in.

Vertical fiber lug: 3 x 4 x 8½ in., 3½ x 4 x 8½ in.

Dunn wire-cut lug: 3½ x 3 x 8½ in., 3½ x 3½ x 8½ in., 3½ x 4 x 8½ in.

Dunn hillside: 3½ x 4 x 8½ in.

Repressed hillside: 3½ x 4 x 8½ in.

The manufacturers' representatives stated that the manufacturers would stand ready to supply the necessary eliminated sizes and varieties required for repair work.

The committee believed that, eventually, additional elminations should be made, but that it was undesirable to attempt to reduce the number of varieties further at the present time.

Permanent Committee

It was voted that the following organizations be asked to designate representatives to serve upon the permanent committee.: American Society of Civil Engineers, American Society for Testing Materials, National Paving Brick Manufacturers Association, American Society for Municipal Improvements, American Association of State Highway Officials, Federated American Engineering Societies, Bureau of Standards, Department of Commerce, Bureau of Public Roads, U. S. Chamber of Commerce.

At the conclusion of the meeting general satisfaction with the character of the proceedings was expressed by Mr. Greenough on the part of the paving brick manufacturers, by R. Keith Compton (sitting for American Engineering Council) representing the engineers, and by F. M. Feiker, assistant to the Secretary of Commerce, on the part of the Department of Commerce. Frank B. Dunn, president of the Dunn Wire-Cut Brick Co., in expressing his approval of the work of the conference, stated that if the royalty on the Dunn patents stood in the way of further simplification he was ready to put the question as to what constituted a proper royalty into the hands of a committee for decision.

Centenarian First President of Public Health Association

Dr. Stephen Smith, founder and first president of the American Public Health Association, who lacks one year of being 100 years old, was the center of interest on several occasions during the fiftieth annual convention of the American Public Health Association in New York City last week.

Dr. Smith was born in Onondago County, N. Y., Feb. 19, 1823, and received the degree of M.D. from the College of Physicians and Surgeons (Columbia), New York City, in 1850. For some years after graduation he was surgeon and later consulting surgeon to hospitals in New York City. Between 1861 and 1874 he occupied various chairs of surgery and anatomy in medical schools in New York City, and during the last part of that period he was the editor of two different New York medical journals.

In 1865 Dr. Smith made a notable report on sanitary conditions in New York City. Following the submission of this report to the State Legislature Dr. Smith was appointed on the New York Metropolitan Board of Health, which for several years had jurisdiction over New York City and adjacent territory. Subsequently Dr. Smith was Commissioner of Health for New York City alone, and also a member of the short-lived National Board of Health. Besides some medical books, Dr. Smith wrote "The City That Was," which was devoted largely to the sanitary campaign in New York City that resulted in the creation of the Metropolitan Board of Health already mentioned (reviewed in *Engineering News*, Oct. 17, 1912, p. 744).

A bronze medal was presented to Dr. Smith at a banquet given in his honor at the convention of the American Public Health Association in New York City last week.

Highway Progress in Washington

According to a recent statement by James Allen, state highway commissioner for the state of Washington, plans and estimates have been prepared, and 60 contracts have been let for a total of 323.58 miles of improvements in the Washington State Highway system since the adjournment of legislature last March 10. The sum total of the contracts is $6,630,000, including 95.69 miles of paving, 197.07 miles of grading and graveling, 46.82 miles of graveling and eight bridges, practically completing the state road program for the year.

Bascule Bridge Failure at Soo

On Oct. 6 the double-leaf Strauss bascule bridge of the Canadian Pacific Ry. over the canal at Sault Ste. Marie, Mich., developed a rupture of the bottom chord of one of the counterweight parallelogram trusses. Railway traffic was interrupted for six days while the leaf was being brought back to closed position by jacking the counterweight. Navigation has since been maintained through the undamaged leaf.

The engineers of the railway company and of the Strauss company are making a joint examination to determine all the facts in the case and decide upon the nature of the permanent repairs. The latter will be carried out when navigation closes.

Survey Canadian Drainage Project from Airplane

The Reclamation Service of the Canadian Government has just completed a survey, by airplane, of a drainage project in the region of the Carrot River, on the boundary between Northern Manitoba and Saskatchewan. The project involves the reclamation of 800,000 to 900,000 acres of land. Much of the area was said to be inaccessible on account of floods.

The engineers of the service are said to have been impressed with the large amount of valuable data secured from the airplane pictures in a comparatively short time. Such surveys, the Canadian authorities point out, are mainly for reconnaissance purposes, and are not to be considered as superceding ground surveys with the usual engineering instruments.

Public Health Convention

(*Continued from p. 869*)

Committee chairmen of the Sanitary Engineering Section for the ensuing year are: Water Supply and Purification, George W. Fuller; Sewerage and Sewage Treatment, W. L. Stevenson; Waterways Sanitation, C. A. Emerson, Jr.; Refuse Disposal, M. N. Baker, Mosquito Extermination, M. Z. Baer; Bathing Places, G. W. Symonds, Jr.; Milk Supplies, H. A. Whittaker; Air, George A. Soper; Constitution, Paul Hansen.

Besides its own technical papers and committee reports, the members of the Sanitary Engineering Section shared in the proceedings of the health conference of the American Society of Civil Engineers, which occupied an afternoon and two evening sessions, at which a large number of addresses, remarkable for their conciseness and comprehensiveness, were presented by specialists in the fields of sewage treatment, the control of offensive odors, and water supply and treatment. Notwithstanding the number of addresses on these subjects, there was ample time for general discussion, so well did the authors of the addresses confine themselves to the time limit set. A stenographic record of the general discussion was made, so presumably the addresses and the general discussion will be published by the American Society of Civil Engineers. A summary of the health conference proceedings, and of some of the technical papers before the Sanitary Engineering Section of the American Public Health Association, will be printed in *Engineering News-Record* next week.

Begin Work Under New Federal Road Act

U. S. Bureau of Public Roads Active in Starting Machinery For Highway Program

(Washington Correspondence)

No sooner had the federal-aid highway bill become a law on Nov. 9 than work was begun at once by the U. S. Bureau of Public Roads to complete the necessary preliminaries for certain important highway projects in an effort to relieve unemployment. All red-tape was cut and the details are to be worked out later after the regulations for the administration of the new law will have been perfected.

The work on the regulations is being hurried so that a complete draft may be ready to submit to the American Association of State Highway Officials at its convention, in Omaha Dec. 5-8. It is the intention to secure the criticisms and suggestions of these officials and others interested before promulgating the regulations. Thomas H. MacDonald, chief of the bureau, states that the highway program is a partnership arrangement between the federal government and the several states, and that there will be no high-handed efforts on the part of the federal government in administering the new act. He points out that the states are furnishing half of the funds and have direct supervision of all the work and as a result they will have every opportunity to be heard before any administrative regulations are promulgated.

Maps of Systems Called For

The principal work in preparing the regulations relates to maintenance and classification of roads; all the states have been called upon to furnish a map showing their tentative road program.

Mr. MacDonald takes issue with the publication of statements that the new law was enacted just in time to save millions of dollars worth of federal-aid roads from going to pieces, due to lack of maintenance. He declares that in no single instance has any federal-aid road "gone to pot," as is being stated. The maintenance feature of the new law was inserted to meet a condition which might arise rather than to correct an existing situation. He attributes no small part of the maintenance work done under the old law to the fact that the facilities of the states to do repair work were enlarged materially by the distribution of $130,000,000 worth of the War Department's surplus property.

New Jersey Defeats $14,000,000 Bonds for Institutions

The voters of New Jersey voted down a bond issue of $14,000,000 for the improvement and enlargement of state institutions on Nov. 8.

Belle Isle Bridge Progressing

Pier construction for the Belle Isle bridge at Detroit is progressing at a rate that promises the completion of six piers by Jan. 1, according to H. H. Esselstyn, representing the designers for the bridge. Pier 15 has been completed up to the base of the steel work, the cofferdam of pier 16 has been unwatered ready for concreting the pier body, and the cofferdam for pier 14 has been sealed ready for pumping. Work on pier 18 is about to begin. In the two piers already unwatered, Mr. Esselstyn states, very little trouble was experienced in leakage through the cofferdams, and there was no indication of any trouble in sealing the bottom against the cofferdam walls, with 4½-ft. concrete base on top of the piles.

National Conference of A. G. C.

The annual conference of the Associated General Contractors of America is to be held in Cleveland on Jan. 17, 18 and 19, 1922. The program has not yet been announced.

Detroit Bridge Authorized By State Utilities Commission

Authority was granted Nov. 17 by the Michigan Public Utilities Commission for the sale of Detroit Bridge securities in the state, on the basis of a total issue of $5,000,000 stock and $15,000,000 bonds of 7 per cent, running 30 years, the stock to be sold at par and the bonds not below 87.

The American Transit Co, which will build the bridge in co-operation with a similar Canadian company working under a Dominion charter, has contracted with the R. T. Scott Co. of Toronto for the sale of the securities. Work on right-of-way surveys, triangulation and borings will go ahead at once. Pier construction is expected to begin next season, by which time also the review of the preliminary superstructure plans will be completed.

The structure to be built is an eight-cable suspension bridge of 1,803 ft. main span, with two decks, for highway and railway traffic respectively, of which only one deck is to be built at the start. W. B. Gregory, of Gregory, Mayer & Thom, is president of the company, and Charles Evan Fowler is chief engineer.

Specifications for Large Bridge in Australia Are Issued

Elaborate specifications have arrived in this country for the construction of a cantilever bridge across Sydney harbor, Australia, from Dawes Point to Milsons Point, bids on which will be received up to Oct. 31, 1922. The specifications and attendant data, in addition to a number of large drawings, fill a book of 115 legal-sized pages which cover even minutest details, including the composition and tests of materials as well as the erection of the bridge itself. However, all stress sheets, working drawings, etc., are to be prepared by the contractor. Announcement is made that J. J. C. Bradfield, chief engineer of the Department of Public Works, New South Wales, will travel through Canada in April and May, 1922, so that prospective bidders may consult with him.

The contract calls for "the manufacture, supply, delivery, construction and erection complete and ready for traffic" of a bridge with a total length of 3,816 ft. The main span is to consist of two 500-ft. cantilever arms and a central section, 600 ft. long, suspended from the ends of the arms, making a total length of main span of 1,600 ft. between pier centers. The height of the trusses over the main piers will be 270 ft. and the height of the central suspended section 100 ft. There will be no movable span, the clearance above high water level being 170 ft.

City Manager Progress and Problems Reviewed

Record Attendance at Chicago Meeting —Now 257 Manager Cities—Bond Limits—Revenue Sources

Almost everything that a public official encounters except engineering was discussed at the eighth annual meeting of the City Managers' Association held Nov. 14 to 16 in Chicago. Police, general administration, finance, welfare, general complaints and ideal attributes of a manager, together with a most spirited debate for and against the city-manager plan for large cities by opposing leaders in the recent Cleveland campaign, were the main topics.

The meeting was the largest yet held, more than 100 being in attendance, of whom about 50 were managers. The movement has gone forward consistently, said Harrison G. Otis, secretary, and now 257 cities, representing a population of 4,630,000, have adopted this plan. Six of the cities are in Canada; 184 operate under charters and 67 by ordinance. Cleveland is the largest city on the list but 49 cities have populations in excess of 20,000 and 103 range from 5,000 to 20,000. Forty cities having the commission form have changed to the commission-manager form. Only two cities, both small, have gone back to the mayor-council form; Brownwood, Tex., which did not have a standard manager form, and Hot Springs, Ark., which had acrid local political difficulties, large debt and an unsolvable liquor problem. Three city-manager charters have been put in force without a referendum: Nashville, Tenn., Clarksburg, Va., and Brunswick, Ga. There is no doubt as to how well they will turn out. Only three cities have home-town managers, the others obtaining out-of-town talent, which is considered far preferable since the manager then has not local prejudices or affiliations to bias his judgment or to hamper his activities.

Organization Aims

While the association assists those interested in the movement and acts as a clearing house for cities seeking managers, Mr. Otis was emphatic in his remarks that the principal aim and work of the organization is to help the members to a better performance of their duties through an interchange of information. In this work 19,000 pieces of mail were sent out by the executive secretary, including 4,500 letters, 2,000 year books, and 4,600 bulletins.

Bonds and Revenue Sources

In a brief paper on "Public Finance" by Charles E. Ashburner, Norfolk, Va., the manager longest in service, it was stated that there is practically no difference in principle between public and private financing. Particularly was he insistent on making the life of bonds co-terminous with the life of the improvements, classifications of which he gave as follows:

"Improvements of short life should in all cases be made from cash or short-term bonds. If from the latter, the bonds should be so arranged that the expiration period of the last bond does not occur at a date subsequent to the life of the improvement. For such equipment as fire apparatus, which soon becomes obsolete, bonds should run for from 5 to 10 years only. High grade

To Complete Alaska Railway

By a vote of 198 to 76 the House of Representatives Nov. 2, passed and sent to the Senate a bill carrying an appropriation of $4,000,000 to complete the construction of the Alaska Ry. A total of $52,000,000 has already been appropriated for construction of this road.

Federal Road Engineers To Meet

Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, has called a meeting of the district engineers of the bureau to take place in Omaha during the week of Nov. 28. At that time the district Engineers will discuss the new highway act with Mr. MacDonald and the division chiefs in the Washington bureau. Most of the officials expect to stay in Omaha for the meeting of the American Association of State Highway Officials which begins Dec. 5.

City Managers' Convention

(*Continued from page 871*)

pavements with car tracks might be listed in the 15-year class while similar improvement without car tracks could easily stand a 20-year obligation. Sewers, buildings and bridges could be financed with 30-year bonds. Land, docks and water-works might very well carry a 50-year bond issue because land should always increase in value if purchased with proper foresight and no city would think of building either docks or water-works that would not have a value at any time during the 50 years at least equal to the outstanding obligation."

At the joint meeting with the National Municipal League, Luther Gulick, chairman of the League's Committee On Sources of Revenue, indicated that taxes rose from $11.50 per $1,000 in 1909 to $21.50 in 1919. The present problem is to "secure the most feathers with the least squawk." Points recommended by the committee are as follows: (1) While it is impossible to separate state and local sources, cities which do four-fifths of the service for the citizen should get a larger part of the taxes than they now do. (2) The extension of occupational taxes would be absurd but inspection fees should be increased. (3) Special assessments are sound and should be extended. (4) Taxing sign boards is sound. (5) With few exceptions limitation of taxes by state legislation is unsatisfactory. (6) In assessments of property 100 per cent of present day value should be used.

William A. Hough, a member of the Indiana tax commission, explained the operation of the 1920 laws by which the commission controls all bond issues. An engineering force is maintained by the commission to check up all issues as to cost and necessity. With reference to road bond issues by counties, townships or districts, Mr. Hough stated that the commission refused permission to their issue when it considered that the estimates were too high. He indicated that contractors' associations are promoting roads merely for the sake of the contracts to be obtained.

The newly elected officers of the City Managers' Association are as follows: President, C. M. Osborn, manager of East Cleveland, O.; vice-presidents, Charles E. Hewes, R. W. Rigsby and Fred H. Locke; executive secretary, H. H. Freeman, Kalamazoo, Mich.

Samuel M. Gray

Samuel M. Gray, consulting engineer, of Providence, R. I., whose death Nov. 5 was noted in these columns last week, was a widely recognized authority in the field of waterworks, sewerage and hydraulics. While the later years of his professional experience had been devoted exclusively to consulting work, Mr. Gray had served for 13 years as city engineer of Providence, and for 30 years was a member of the State Board of Health of Rhode Island.

A list of the works designed and constructed by him covers scores of cities, not only in the United States, but in Mexico and Canada, among his most important assignments being the design of the reconstructed water-works at Baltimore costing $2,000,000, the remodeling of the sewage treatment plant at Worcester, Mass., the design of Baltimore's large sewage treatment works and sewerage system, on which Mr. Gray was one of a board of three consulting engineers, the design of a complete system of intercepting sewers for the District of Columbia, and the investigation of the contamination of the water supply of Philadelphia, involving slow sand filtration works at a cost of $30,000,000.

Was Assistant to J. H. Shedd

Mr. Gray was born in Andover, Mass., in 1842 and after leaving school began his engineering career on railroad construction in Connecticut. Going to Providence in the early sixties, he secured a position as assistant to the late J. Herbert Shedd, then chief engineer for the new water supply for Providence.

His work received favorable notice and in 1877 he was selected city engineer of Providence, a position which he held for more than 13 years. His duties included also supervision over the departments of water-works, sewerage, bridges, and highways. While in that position the city sent him on an extended European trip for the study of sewage disposal methods, and he visited England, France, Germany, Italy, and Holland.

Mr. Gray resigned as city engineer of Providence in 1890 and opened an office as consulting engineer, specializing in municipal and sanitary work, and continued in this field almost up to the time of his death. During his thirty-one years of consulting practice he has been retained on water or sewerage works for Baltimore, Louisville, Ky., Havana, Monterey, Mexico, Toronto, San Antonio, Philadelphia, Worcester, Mass., Syracuse, N. Y., Binghamton, N. Y., and other cities.

In 1913, when over 70 years old, Mr. Gray was selected as engineer for the study of a new water supply for Providence and held that position until the general plans for the new work were developed. He was then retained as chief consultant up to the time of his death. In 1892 Mr. Gray served as vice-president of the American Society of Civil Engineers.

Railroads Cut Rates on Farm and Dairy Products 10 Per Cent

A reduction of 10 per cent in carload freight rates on farm products is to be put into effect immediately and without waiting for a reduction in wages, according to a recent announcement made from the offices of the Association of Railway Executives. The reduction is to apply throughout the United States, except on traffic moving wholly within New England. The reduction applies to certain grain and grain products, fruits, vegetables, cattle and hogs, and dairy products. Any reduction that has been made in such rates since Sept. 1, 1920, is to constitute a part of the 10 per cent reduction.

Federation's Annual Meeting To Be Held Jan. 5 and 6

The annual meeting of the American Engineering Council of the Federated American Engineering Societies will be held in Washington, D. C., Jan. 5 and 6, according to an announcement just made by L. W. Wallace, executive secretary, who says in part:

"The Executive Board should give serious consideration to methods of informing engineers as to the aims, policies and activities of the federation. Some member societies have been and are now, perhaps, rather indifferent to a continuation of their affiliation. As far as we have been able to ascertain, this condition is due to the officials and the members of such organizations not being fully informed.

"While it may be true that during the first years the federation has not been able to accomplish all that was expected on the part of some and that it has not fully found itself, so to speak, yet the progress has been such as to justify optimism rather than pessimism as to the future usefulness of the federation. The federation has been fairly well established in the minds of the public and in government circles. This is evidenced by the character and quantity of publicity that the federation has received."

General Activities

The general activities of the federation during the year, according to Mr. Wallace, have included the following: Assistance in organizing a conference of engineers to consider the advisability of fall letting of highway construction contracts; co-operation in arranging for the Unemployment Conference; promoting the movement for a National Department of Public Works; appointment of a committee to frame a plan for a permanent employment service; adoption of a policy to avoid confusion and antagonism on the question of licensing of engineers; conferences with a committee of the American Association of Engineers; investigation by Committee on Elimination of Waste in Industry; establishment of a federation bulletin and digest service.

The federation has now more than 43,000 members. President Mortimer E. Cooley and Mr. Wallace are now carrying out plans for more intensive organization, aiming particularly to link up the member societies in a more cohesive scheme of action so that the influence and benefits of the federation may be more directly and systematically communicated to the societies.

Indianapolis Plans Public Works Program Under New Engineer

Lew Shank, mayor-elect of Indianapolis, has directed John L. Elliott who, he has announced, will be city civil engineer in the next administration, to make a survey of the city and determine what public improvements are most needed. Many additions to the city's sewer system in both the downtown and residence districts will be necessary soon, according to Mr. Elliott, and this may be a part of the work determined on for the next four years, The rapid growth of the city to the north has given too great a load for the capacity of the sewer system in the central part of the city. It may be necessary to construct relief sewers in the downtown district, or provide for storm overflows into Pogue's Run sewer. Within the next year a large new sewer system in the northern part of the city and Broad Ripple, will be placed in use, and this will add to the overload now carried in the central part of the city.

The general program of track elevation for the east, south and west parts of the city, Mr. Elliott believes, should be pushed as rapidly as the financial condition of the railroads will permit.

Associations Call Conference on Standard Contracts

Means for bringing about uniform contracting practice and standard contracts will be discussed at a conference in Washington, D. C., Dec. 15, 1921, in which leading engineering and contracting associations will participate. In the call for the conference it is urged that that standard contracts will reduce legal expenses, decrease duplication of work, eliminate dispute, safeguard owners, increase public confidence and raise the standard of construction service.

It is thought that standardization can be approached by a segregation of general and special contract principles, placing those which pertain to all work in a standard document. Such a primary document would convey to everyone the main governing principles of construction obligations, leaving the secondary and complementary document the special stipulations. The first can be selected and approved by all of the technical societies and the second can be drafted by those best able to speak for an individual field of construction.

When the process of standardization has been carried out the field of construction contracts would then be covered by (1)) The universal document for all work, preferably called The Agreement; (2) several sets of special principles, one for each type of work, for example, one set for railways, another for buildings, another for waterworks, and so on to the desired extent. These documents might preferably be designated "The General Conditions" of each type.

The associations co-operating in the conference are: The American Association of State Highway Officials; the American Engineering Council; the American Institute of Architects; the American Railway Engineering Association; the American Society of Civil Engineers; the American Water Works Association; the Associated General Contractors of America; the National Association of Builders' Exchanges; and the Western Society of Engineers.

Further Amendments to Civil Engineers' Constitution

The American Society of Civil Engineers is sending to its corporate members notice of the proposal of amendments to the new constitution, which was adopted by letter ballot last month. The amendments are in two groups, those fathered by the Board of Direction and the now expired Committee on Referred Amendments, and those proposed by a number of members headed by Richard L. Humphrey and made up largely of men from Philadelphia.

The first group, three in number, merely provides for formally taking care of omissions in the constitution as adopted, and, with reference to the nomination of officers, for definitely limiting the counting of ballots by district and zone limitations to the first and second canvasses, thereby preventing the possible interpretation that such limitation applies also to the final ballot.

The amendments fathered by the group headed by Mr. Humphrey would, (1) remove the members not residing in North America from District No. 1; (2) substitute for the ballot primaries a series of district and zone nominating boards; (3) establish an annual conference of representatives of local sections, to which mileage would be paid by the parent society for one representative from each section; (4) allocate each member of the society to some local section and make it obligatory on the Board of Direction to allocate to each section an annual sum from the funds of the society.

In the proposed new method of election the candidates nominated by the district and zone nominating boards, plus additional nominations made by declaration on which local sections would have voting power in proportion to their respective memberships, would be voted upon by the corporate members in the respective districts and zones. The candidate getting the highest number of votes would be certified to the annual convention of representatives of local sections, which convention would nominate the candidate for the presidency.

Trucks Start to Destroy Test Concrete Road

Thirty-six 5-Ton Units Begin Journey Around Track at Pittsburg, Cal.

Traffic was started Nov. 9 on the experimental concrete road at Pittsburg, Cal., which is to be tested to destruction by motor trucks. For use in the test the U. S. Bureau of Public Roads supplied 18 trucks with drivers and another 18 trucks were donated by the California Highway Commission. Two California highway commissioners, representatives of automobile associations, and about one thousand spectators, including a large percentage of engineers, witnessed the start of the test. A description of the experimental road and its purpose appeared in *Engineering News-Record*, Aug. 18, 1921, p. 276.

All the trucks were of 5-ton capacity, equipped with solid tires and loaded with pig iron to give a gross weight of 14,500 lb. each. They are to be operated 8 hours per day until the life of the thirteen various types of pavement is determined. Eighteen of the trucks travel around the elliptical roadway in one direction and the other eighteen in the opposite direction at an average rate of 10 miles per hour, thus each truck makes about 40 trips per hour and each section of the pavement will be traversed 11,520 times per 8 hours.

By means of gages and integrating devices in tunnels beneath the pavement, records are being made of the deflections in various sections of the concrete slab and subgrade, temperature readings are being recorded and by means of lines dividing the entire pavement area into 6-ft. squares a progressive record will be kept of surface conditions

Trend of Engineering Employment Shows Improvement

A tangible indication that the demand for engineering services is increasing comes from the employment report for October of the American Association of Engineers. During the month almost the same number of men registered for employment as during September but of these only 45 per cent were actually unemployed, which is 10 per cent less than for September. More positions were received and more men placed all over the country than in the previous month. The following table shows the trend.

	October, 1921	September, 1921	October, 1920
Applicants for employment	1,877	1,749	1,602
Positions received	384	348	694
Men referred	1,731	1,861	3,357
Men placed	240	213	301

The average salary of positions filled in October was $186, or $2 more than last month. For the same month last year it was $203. The oldest man that registered was 68 and the youngest 18. The average age was 36 and the average years of engineering experience was more than 10. The highest salary desired was $12,000 and the lowest $90 a month. The average salary applicants would consider was $210 a month. Of the men registered for employment 61 per cent were university graduates; 40 per cent were classified under civil engineering positions. The greatest demand for engineers was in appraisals, industrial and public utilities, structural and architectural designing. The demand for construction engineers was small.

California Highway Bonds Sold At Premium

A $5,000,000 block of California State highway bonds bearing 5½ per cent interest were offered for sale at public auction in Sacramento, on Oct. 27. A large number of San Francisco banking houses were represented and after spirited bidding the bonds were sold to the Anglo & London Paris National Bank of San Francisco at a premium of $476,-

000. After the sale state officers stated that under present conditions these bonds would have found a market if their interest rate had been as low as 5½ per cent.

The interest rate on each block of California highway bonds is now fixed by a commission just before the block is put on the market. The plan was described in *Engineering News-Record*, Nov. 11, 1920, p. 962.

Road Builders Elect Officers and Change Constitution

At the annual meeting the American Road Builders' Association held in New York City, Nov. 15, officers for the ensuing year were elected as follows:

President, H. L. Bowlby, chief, War Materials Division, U. S. Bureau of Public Roads; vice-presidents, Charles J. Bennett, State Highway Commissioner of Connecticut, New Haven, Conn.; Frank Page, chairman, North Carolina State Highway Commission, Raleigh, N. C.; A. R. Hirst, State Highway Engineer of Wisconsin, Madison, Wis.; W. W. Crosby, National Park Service, Estes Park, Colo.; secretary, E. L. Powers, Editor, *Good Roads*, New York, N. Y.; Treasurer, Senator James H. MacDonald, former State Highway Commissioner of Connecticut, New Haven, Conn.

Several changes to the constitution and by-laws of the association were approved, the most important being a change in the date of the annual meeting from November to May and a change in the method of electing officers. Under the new provisions officers will be elected from among the directors by the directors. Vacancies on the board will be filled each year by a nominating committee of seven selected from the board of directors. Another change makes the president eligible for re-election. By holding the annual meeting in May, the new officers will have a longer time in which to lay plans for the annual convention and exposition. Arrangements were made to hold the next good roads congress and show at the Coliseum in Chicago, Jan. 17 to 20, 1922.

Department of Commerce Names Zoning Committee

In order to make available a concensus of opinion regarding good practice in zoning ordinances the U. S. Department of Commerce has organized a committee to inquire into and report on the subject. Its importance is indicated by the adoption of zoning laws by 40 cities and towns and the consideration of such laws by 70 additional municipalities.

The membership of the committee and the organizations represented follow:

Louis A. Moses, National Association of Real Estate Boards; J. Horace MacFarland, American Civic Association; Nelson P. Lewis, National Municipal League and National City Planning Conference; Lawrence Veiller, National Housing Association; Morris Knowles, of Pittsburgh; Edward M. Bassett, chairman Zoning Committee of New York; Frederick Law Olmstead, president, Society of Landscape Architects; and John Ihlder, U. S. Chamber of Commerce.

John M. Gries is chief of the department's Division of Building and Housing, under which the committee acts.

Discussion of Joint Committee's Concrete Specifications

The program of the two-day discussion of the Standard Specifications on Concrete of the Joint Committee of Concrete and Reinforced Concrete, is as follows:

Dec. 7.
- 9 a.m. Chap. IX. Waterproofing and protective treatment. Chap. X. Surface finish.
- 2 p.m. Chap. VI. Depositing concrete. Chap. VII. Forms. Chap. VIII. Details of construction.
- 8 p.m. Chap. XI. Design.

Dec. 8.
- 9 a.m. Continuation of discussion of Chaps. VIII and XI.
- 2 p.m. General discussion of the tentative specifications for concrete and reinforced concrete and of the scope of the Joint Committee's work.
- 8 p.m. Chap. III. Quality of concrete. Chap. IV. Materials. Chap. V. Proportion and mixing concrete.

Under the auspices of the American Society of Civil Engineers.

PLACE. — Engineering Societies Bldg., New York City.

TIME. — December 7 and 8.

California Road Contract Sought By Twenty-Two Firms

Sharp competition characterized the bidding for the first 7½-mile section of the Ocean Boulevard, which, when completed throughout, will connect the coast highway between Oxnard and San Juan Capistrano, and give Southern California 250 miles of uninterrupted coast-line highway. Twenty-two contracting firms submitted bids to the California Highway Commission for this work, which included grading a 40-ft. section and paving with cement concrete 20 ft. wide 6 in. thick, reinforced with steel rods. The bids ranged from $445,864 to $260,739. The engineer's net estimate on this section was $286,227.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS; Annual Meeting, Omaha, Neb., Dec. 5-8.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York City; Annual Meeting, New York City, Dec. 5-9.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Conference, Cleveland, Ohio, Jan. 17-19.

FEDERATED AMERICAN ENGINEERING SOCIETIES (American Engineering Council) Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 5 and 6.

The Colorado Section, Am. Soc. C. E., at its monthly dinner and meeting in Denver, Nov. 14 heard H. L. Thackwell propose a plan for the construction of a ten-story Engineers Building in Denver for the use of consulting engineers and architects. A committee was appointed to investigate the feasibility and outline a scheme for financing the project. The meeting also endorsed the bill now pending in Congress providing for the commissioning of sanitary engineers in the U. S. Public Health Service. R. H. Fox, expert on bearings, gave a lantern slide lecture on the "Development and Application of the Ball Bearing."

The Providence (R. I.) Engineering Society, at its meeting Nov. 15 was addressed by Alfred D. Flinn, secretary, United Engineering Society and Engineering Foundation and chairman, Division of Engineering, National Research Council, on "The Engineer's Road to Peace: Co-operation, Past, Present and Future."

The Engineers' Club of Cincinnati and the Cincinnati Section, Am. Soc. C. E., held a joint meeting Nov. 17 which was addressed by Ralph N. Begien, general manager, Baltimore & Ohio R.R., whose subject was "The Immediate Future of Railroad Development."

The Jackson (Mich.) Engineering Society, at its meeting Nov. 7, was addressed by Prof. A. C. White, director of engineering research at the University of Michigan.

The New York Assembly, A.A.E., at its meeting Nov. 12 in Albany, elected the following officers: President, Germain P. Graham; vice-president, G. P. Hevenor; second vice-president, W. L. Everett; secretary-treasurer, J. G. Brennan.

The New Jersey Association of County Engineers held its Fall meeting and inspection Nov. 18 and 19, with Delaware, Pennsylvania and New Jersey state highway engineers as guests. Highways in Mercer, Middlesex, Monmouth and Burlington counties were inspected. One of the subjects under discussion at the evening session Nov. 18 was the advisability of counties building part of state highway system under the reimbursement act, as proposed by State Highway Commission.

The Eastern Paving Brick Manufacturers Association will hold its annual meeting at the Pennsylvania Hotel, New York City, Dec. 13 and 14.

The Utah Society of Engineers, at its meeting Nov. 16, in Salt Lake City, was addressed by B. J. Finch on "Utah's Highway Needs."

The Iowa Section, Americal Water Works Association at its annual meeting Nov. 1, 2 and 3 in Omaha, elected the following officers: Chairman, J. Chris Jensen; vice-chairman, Peter Kern; directors, Harvey P. Letton and C. L. Ehrhart; secretary-treasurer, Jack J. Hinman, Jr., Iowa City.

The Municipal Engineers of the City of New York, at a meeting Nov. 22, was addressed by Daniel L. Turner, consulting engineer to the New York Transit Commission on "Moving Platforms." He discussed the problem of relieving transfer congestion between the east and the west side subways at 42nd Street, New York. H. S. Putnam, consulting electrical engineer discussed the electrical carrier system as adapted to the operation of moving platforms.

PERSONAL NOTES

L. E. BARKER, formerly engineer for the Pima County (Ariz.), Highway Commission, has been appointed engineer with the Yavapai County Highway Commission.

GEORGE A. MCCLELLAND, formerly district engineer of the Texas Highway Commission, has been appointed engineer of Harrison County, Tex.

IRA W. MCCONNELL, vice-president and chief engineer for Dwight P. Robinson & Co., Inc., engineers and contractors of New York, is in South America, where he will be engaged for a number of months on the company's construction projects in Brazil. The work includes the construction of a number of dams.

H. E. SURMAN, formerly district engineer at Dixon, Ill., with the Highway Division of Illinois Department of Public Works and Buildings, in charge of the planning, construction and maintenance of state roads in the district, has been appointed engineer of design with the department, succeeding Frank T. Sheets, and will have charge of the planning of all state roads, with headquarters at Springfield. Mr. Sheets' promotion to superintendent of highways was noted in these columns Sept. 29, p. 542.

HOWARD M. SMITTEN, assistant engineer in the valuation department of the Southern Pacific, has been appointed bridge engineers of the Western Pacific R.R., with headquarters at San Francisco.

HARRY P. GRIER, of Statesville, N. C., county engineer for Iredell and Alexander counties, has been appointed district engineer for the Asphalt Association, with headquarters in Raleigh, N. C.

JOHN P. LEO, has resigned as commissioner, Department of Street Cleaning, New York.

E. P. JOHNSON, formerly division engineer, Section 1, Welland Ship Canal, has been appointed division engineer, Section 5, in which capacity he will also have supervision of survey work and plans for Sections 6 and 7. His headquarters will be at Welland.

BARTON M. JONES, for 7 years connected with the Miami Conservancy District at Dayton, Ohio, recently as division engineer having direct supervision of the construction of the Lockington dam, has been given local charge, by the Dayton Morgan Engineering Co., of the flood prevention work at Pueblo, Col.

CARL T. BOWEN, for the past two years connected with the Michigan State Highway Department, has been appointed engineer and superintendent of roads in Ottawa County, Mich.

H. E. BRENCHLEY, structural contracting manager of the Minneapolis Steel & Machinery Co., New York, has been elected vice-president of the Structural Steel Society at its meeting in Chicago, Nov. 8.

HERBERT ABRAHAM, chemical engineer and chairman of the Technical Committee of the Prepared Roofing Association, Chicago, has been appointed a member of the technical committee of the Asphalt Association, New York.

F. A. DAVIDSON, of the Dwight P. Robinson Co., of New York City, has been elected chairman of the construction section of the National Safety Council.

H. W. FORSTER, of the Independence Bureau, Philadelphia, has been elected chairman of the engineering section of the National Safety Council.

J. W. BEARDSLEY has resigned as engineer member of the Highway Commission of the Republic of Panama. This position includes the duties of chief engineer and of executive officer of the commission. He was formerly director of public works, P. I., and chief engineer of the Porto Rico Irrigation Service.

JOHN L. ELLIOTT, now senior assistant city civil engineer, of Indianapolis, has been appointed city civil engineer by Lew Shank newly elected mayor. Mr. Elliott replaces Frank C. Lingenfelter, for whom no place has been provided in the Shank administration.

ERNEST F. NICHOLS, president of the Massachusetts Institute of Technology, has resigned his office because of ill health, and his resignation has been accepted by the executive committee of the corporation. He has been given a leave of absence until Jan. 4, 1922, when the next meeting of the corporation will be held and the action of the executive committee will be ratified.

MOSELEY & FOUNTAIN is a firm of consulting, designing and supervising engineers recently organized with offices in Dallas, Tex., by Hal Moseley, for two years city engineer of Dallas, and, later, commissioner of public works of Dallas, and by Thomas L. Fountain, for five years senior member of the firm, The Fountain-Shaw Engineering Co., Dallas, for two years engineer of sewerage for Dallas, and recently principal assistant engineer with J. D. Trammell, consulting engineer, Fort Worth, Tex. Both members of the new firm served as captains, Engineers, with the A. E. F. in France.

R. K. WEST, formerly principal assistant engineer California Highway Commission, and later chief engineer of highways of Nevada and, during the war, captain, Engineers, A. E. F., has been appointed acting chief engineer of the highway commission, Republic of Panama.

OBITUARY

I. T. GOODWIN, JR., of Athens, Ga., division engineer, Georgia Highway Department, was killed in an automobile accident, Nov. 9, while on an inspection tour of roads near Covington, Ga. He was graduated from the University of Georgia in 1912 and was a veteran of the World War.

WILLIAM GRACE, president William Grace Co., contractors, Chicago, died Nov. 6, at Barrington, Ill. He was borne in Hull, England, in 1847 and came to this country in 1871. Early in life he was associated in Chicago with John Griffiths and F. D. Hyde. Mr. Grace built the La Salle St. station, the county building, and many other large buildings in Chicago and New York.

G. PRESTON BRADY, civil engineer, at one time connected with Campbell & Lattimore, contractors on the foundation work for the High Level Bridge at St. Catherines, Ont., and later engaged in drafting work for the Pere Marquette Ry. in connection with valuation work was killed in a street accident in Troy, N. Y., recently.

EQUIPMENT AND MATERIALS

Motor Truck with Scraper Blade

A scraper attachment for maintaining gravel roads is being attached to its 2½-ton special road maintenance truck by the Republic Truck Sales Corporation of Alma, Mich. Lighter trucks can be equipped but the size

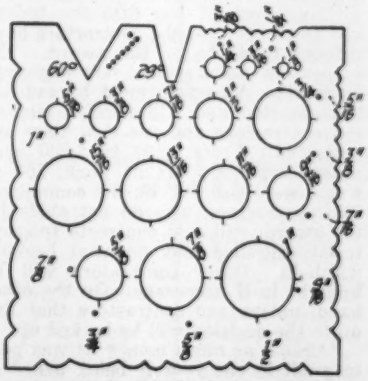
named has the pulling power and weight which seem best suited to efficient operation of the scraper.

The scraper is a blade edged with ⅜ x 2 in. steel mounted on four steel springs 6 in. wide, which are mounted on a round, hollow bar which is adjustable by means of a chain and ratchet post. The bar is mounted on a 2 x 6 in. oak timber through adjustable brackets, and this timber is then mounted on the chassis frame, with brackets and braces. When not in use the scraper is raised and gives a clearance of 8 in. under the lowest point.

An operating speed of 8 to 12 miles per hour gives the best results. Several of these trucks have been working this season on gravel roads in Kent County, Michigan.

Useful Drawing Board Device

A device to aid the draftsman in drawing screw threads, nuts, fillets and circumferences without using rules,



compass and tables is being sold by the Lopez Manufacturing Co., Chicago, Ill. With the device, screw nuts from $\frac{1}{16}$ to 1 in.; circumferences from $\frac{1}{8}$ to 9$\frac{1}{16}$ in.; 60 deg. screw threads; 29 deg. Acme threads, and radius and fillets corresponding to the circumferences, can be drawn directly. The device is made of transparent material and is 4$\frac{1}{2}$ in. square.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Engineering News-Record's Cost Index for 1920 and 1921

Engineering News-Record's Construction Cost Index Number is being computed monthly back to 1913, and each week a year's figures will be published in these pages. The Numbers from January, 1920, to November, 1921, are given in the following tabulation, and the figures are plotted in the chart accompanying the article on this page, entitled "Construction Industry Has Been Waiting for Steady Prices." The Numbers for the months of 1919 will be presented next week.

	Eng. News-Record Construction Cost Index Number
1913	100.00
1920	
January	206.55
February	225.10
March	240.85
April	265.20
May	268.90
June	273.80
July	265.65
August	252.00
September	255.20
October	255.20
November	255.32
December	251.62
1921	
January	230.87
February	230.67
March	224.27
April	213.02
May	210.82
June	209.82
July	203.82
August	193.07
September	188.27
October	182.57
November	166.32

Chicago Determines to Rid Itself Of Building Restrictions

So far as the carpenters, plumbers and five other trades are concerned Chicago is to be an open-shop city unless they accede to the Landis award. At a huge mass meeting sponsored by the Chicago Association of Commerce, T. E. Donnelly of the citizens committee to enforce the award and other representative business men, clearly indicated what would take place.

Only seven of the fifty-one unions and 15 per cent of the contractors have refused to abide by the award. The carpenters' union cannot now negotiate contracts. An employment bureau has been started and will furnish men to the contractors and see that they are protected. From 1,100 to 1,200 non-union carpenters are at work, 200 of whom were supplied by the committee. The contractors, who do not abide by the award, will find contracts for material cancelled and financial backing withheld. Other contractors will be brought in if necessary. On the other hand, unions and contractors that live up to the decision will be backed up.

"Almost as much money as was paid in graft in one year is being asked of the business men by the citizens committee to clean up the situation," said Mr. Donnelly.

We'll make this section what you want it to be—provided you tell us frankly what you want.

Construction Industry Has Been Waiting for Steady Prices

Contracts Let Shown in Terms of 1913 Purchasing Power—Chart Includes E. N. R. Cost Index Number

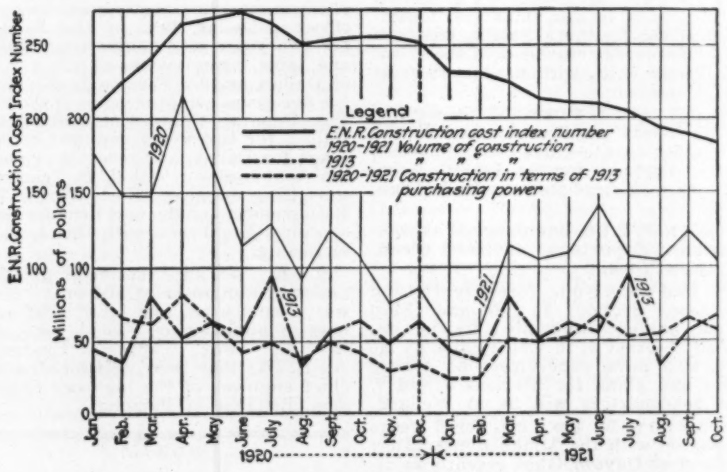
It is agreed that except for industrial works the country is underbuilt. It is generally believed that 1921 is an off year for construction. A definite reason for this paradox is the price situation.

Prices have fallen steadily since the peak in the summer of 1920. The *Engineering News-Record* Construction Cost Index Number shows this decline—fairly evenly downward in 1921. The chart giving the cost index number also carries the monthly volume of contracts let on all classes of engineering construction in 1920, 1921 and 1913.

Comparison of the actual volume of contracts let in 1920 and 1921 with 1913—as differing from a mere comparison of amounts of money—may be made by using the cost index number. By this means the actual volume of construction in 1920, computed from the total of contracts let, was 9 per cent less than the 1913 volume. Construction, or contracts let, in 1921 to Nov. 1 is 15 per cent less than in the ten months of 1913. This means that the amount of construction this year is 85 per cent of the amount in 1913.

Uncertainty as to future prices has been a major factor in this falling off of construction. Construction cost has declined 39 per cent since the peak in June, 1920, and is now about 66 per cent above the 1913 level. These figures include also the cost of labor. For the entire country common labor has fallen from 64 cents per hour to an average of 45 cents. In certain sections rate-cutting has been radical, while elsewhere, as in New York, peak rates are still in force. Common labor can be hired in the South for as low as 15 to 20 cents per hour. The 1913 average for the country may be taken as 22 cents per hour. It is therefore probable that labor cost will continue to decline in 1922, and this will work to draw certain materials below present levels.

If prices thus continue their decline there will remain a measureable uncertainty in the construction industry. It must be borne in mind, however, that any future decline in prices will not be from a peak, but from levels that are already satisfactory in many instances. Therefore, there should not be anything like the uncertainty that has prevailed since the summer of 1920 to date. Furthermore, the volume of construction of an urgent nature is steadily swelling and a certain proportion of this must be released, irrespective of market conditions. It seems safe to predict that 1922 will be a considerably better construction year than the present, and that the years following will show the Construction Industry really catching up.



TWO YEARS OF E. N. R. COST INDEX; AND CONSTRUCTION VOLUME FOR 1913, 1920 AND 1921

Cement Output Up in October

Cement shipments for October exceeded production and were the largest recorded for a single month. Stocks of finished cement at the mills at the end of October were approximately 5,348,000 bbl., compared with 6,953,000 bbl. at the beginning of the month. The production of clinker, or unground cement, in October was approximately 9,891,000 bbl. Clinker production for the ten months amounted to approximately 82,419,000 bbl., or an average of 8,241,900 bbl. per month.

Reliable Pine Pile Prices

This list of current prices covering the sizes and lengths of pine piles used in the New York district has been compiled for *Engineering News-Record* by Conwell & Co., Norfolk, Va., which company will hereafter supply the pine pile quotations in the Monthly Prices of Construction Materials—next issue Dec. 1. Says W. W. Conwell, president:

"In making this schedule we have exercised the same care as we would had we been bidding on a project requiring timber of the lengths and sizes mentioned, and in fact they are the same prices we would quote to any of our customers in the above noted territory. We trust that the data will serve the purpose intended, at any rate we know that it is sufficiently comprehensive to enable any contractor to use it making estimates. We are really pleased to be of service to you in this matter, for we feel that these prices may serve as an inspiration to people who have prospective work to do and to get them started to doing it is a consumation to be devoutly hoped for."

PRICES PER LINEAL FOOT, PINE PILES WITH BARK ON, F.O.B. NEW YORK

Diameters	Points	Length	Barge	Rail
12 in. at butt.....	6 in.	30 to 50 ft.	$0.14	$0.19
12 in.–2 ft. from butt.	6 in.	59 to 59 ft.	.18½	.25
12 in.–2 ft. from butt.	6 in.	60 to 69 ft.	.21	.27½
14 in.–2 ft. from butt.	6 in.	50 to 69 ft.	.24	.23½
14 in.–2 ft. from butt.	6 in.	70 to 79 ft.	.2[illegible]	.34½
14 in.–2 ft. from butt.	5 in.	80 to 89 ft.	.3[illegible]	.42

Lumber Shipments Equal Orders

Figures for production, stocks and shipments furnished by the Southern Pine Association show that in the forty-two weeks ending Oct. 22 there were orders for 3,112,881,817 ft. b.m. of lumber. Total shipments reached 3,058,102,397 ft. b.m., of which 2,914,838,279 ft. b.m. were actually cut during that period. The West Coast Lumbermen's Association reports for the same period orders for 2,321,762,205 ft. b.m.; shipments, 2,268,825,776 ft. b.m. and production, 2,167,219,909 ft. b.m.

For the period ending Oct. 22, the combined report of these two associations showed shipments as great as the demand; indicating an increase in shipments and a decrease in demand in certain centers, from the recent high point. Production for the week ending Oct. 22 is the highest recorded this year. Recent price advances have stimulated the opening up of more mills.

Latest News—Orders for southern pine have fallen off during the last two weeks from the high period of the year established during September and October. Orders for the week ended Nov. 14 were only 68,000,000 ft. b.m. or about 8 per cent below the production for that week. Shipments have not fallen so greatly, the average shipment per mill since the first week in September being in excess of 600.000 ft. b.m., the figure attained the week ended Nov. 14.

The actual production for the week of Nov. 14 was 74,000,000 ft. b.m. or 18 per cent below normal. The total orders on hand amounted to 255,000,000 ft. b.m.

The West Coast Lumbermen's Association has started its long deferred litigation for lower rail freight rates and simplified tariffs. Shippers of West Coast forest products have tried out the increased rates now for more than a year, with the result that lumbermen are losing markets and the railroads are losing revenue. The governing board of the West Coast Lumbermen's Association is convinced that lower rates would have a tendency toward earning more revenue for the railroads, at the same time giving the East access to an abundant supply of lumber with which to meet its housing situation. The Association claims its attitude is co-operative.

Trend of Business

Stock Market—More activity last week than the week before, with rising prices; but business is chiefly of a professional nature. With money more plentiful there is the possibility of a bull market developing in the course of several months; ungoverned speculation, however, is not likely, stocks being in strong hands.

Bonds—Public interest centered in new flotations, which frequently are disposed of a few days after offering. Subscriptions to the $50,000,000 New York Telephone Co. refunding mortgage 6s totaled over $450,000,000, at about 100, despite the fact that a week before a similar investment with the same company was available at 98. The tremendous interest in this issue helped the high-grade public utility bonds. Municipals retained strength despite many new issue. Railroad bonds advanced, though trading was light.

Money—Call loans 4 to 5½ per cent, with as low as 3½ reported outside New York; time money at 5 per cent.

Foreign Exchange—Sterling rose to $4.50, the high price of the year, the previous record being $4.25 on May 19.

Textiles—Extremely small demand, with falling prices.

Steel—Ingot production at 40 to 45 per cent capacity, against 44 per cent for October, and an increase hardly expected before Feb. 1. The total annual capacity is about 52,000,000 gross tons of ingots, 40,000,000 gross tons of finished rolled steel. Armament making takes less than one per cent of capacity, so a naval holiday should not seriously affect the industry. Railroad buying in October estimated at $50,000,000, and prospects for still heavier buying are good.

West Coast Lumber for Coney Island Broadwalk

The lumber contract for surfacing Coney Island's new boardwalk has just been awarded a San Francisco concern on specifications calling for 1,360,000 ft. b.m. of 2 x 4-in. vertical grain Douglas fir of the decking grade. The contract calls for 760,000 ft.b.m. of Douglas fir in 23-ft. lengths; 650,000 ft.b.m. in 18-ft. lengths; and 250,000 ft.b.m. in lengths of 12 ft. and up.

Engineering News-Record's Materials Prices

Weekly Market Compiled by Nine Reporters; Monthly List the Work of Twenty

One of the chief difficulties in the way of presenting accurate and definite price information useful to engineers, contractors and sellers of construction materials, is the fact that a price in itself means next to nothing. Quotations always require explanation. It is not enough to say that cement costs $2.40 per bbl. in New York. Cement also costs $2.10 in New York. It all depends whether the contractor or dealer is buying. Again, if the charge for bags is added, cement then costs $2.80 and $2.50, to contractor and dealer, respectively. Carrying the explanation further, the contractor's price includes delivery on the job, while the price to dealers is "alongside dock."

As in the case of cement, so with lumber, sand, gravel, crushed stone, brick, lime, and the rest. Methods of basing quotations vary with the different classes of materials, and the methods prevailing in one city may be entirely different from those in another center. In New York *Engineering News-Record* quotes sand, gravel and stone alongside dock, because contractors are permitted to purchase these materials on that basis. Cement, on the other hand, must be bought through dealers, who quote only delivered prices. In certain other cities, where cement may be obtained directly from the manufacturer, we quote f.o.b. City.

The fullest use of the prices of construction materials published by *Engineering News-Record* requires that the quotations be thoroughly understood. The weekly market or basic materials carries a complete explanation in small type directly under the tabulation of prices from nine important cities. The complete list, published in the first issue of each month, contains as much explanation as is possible without making the price section cumbersome. Also, a rapid, skeleton review entitled "Ups and Downs of the Market" leads the monthly list of prices.

Turn the page and study the Weekly Construction Market. It is as accurate as watchfulness and nine price reporters can make it. Next week's issue, Dec. 1, will carry the monthly labor article and the full list of prices of construction materials.

Recent Municipal Bond Sales Total $60,890,970

More than $60,000,000 in municipal bonds have been sold recently in thirteen states and more than $34,000,000 in addition have been offered for sale. Besides, $10,000,000 in state bonds have been sold and an equal amount has been offered for sale. These statistics have been compiled as a part of a study being made regarding public works and the possibility for hastening construction to relieve in some measure the nation's unemployment. The statistics were compiled by the President's Conference on Unemployment. Public works, which it is hoped will be erected or extended by these municipal bonds, include highways, schools, sewers, filtration plants, water works, hospitals, parks, forest reserves, bridges, lights,

paving, court houses, fire department and street department equipment, streets and sidewalks, beach improvements and memorial playgrounds.

Col. Arthur Woods, chairman of the committee on civic and emergency measures of the President's Conference on Unemployment, is in correspondence with mayors of cities of more than 20,000 inhabitants to learn the status of their unemployment and what emergency measures are being taken to provide employment for men and women who need it.

Vanderlip on a World Bank

The temptation to enter upon a process of depreciation by issuing too much paper money on the theory that what has seemed to help German industry might do something for manufacturers in other countries was declared by Frank A. Vanderlip, the American banker, recently, to be a certain path to national bankruptcy. As a means of stabilizing international finance he has put forward the idea of a world bank, with an international dollar.

According to Mr. Vanderlip the plan would leave every finance free to go on printing as many notes of his own national currency as he please; it would merely establish a double currency, such as already exists in some of the South American countries and in the Far East. In brief, the proposition is to organize a banking corporation with a paid-in capital of $1,000,000,000 in gold, with power to increase, the capital to be divided into shares of $100 each. Subscription to these shares would be open to anyone able to buy with gold.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of November 3, the next, on December 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	–$2.78	$4.00	$4.00	$2.88	$3.06	$3.75	$3.70	$4.00	$4.00
Structural rivets, 100 lb.	3.70	5.25	5.50	3.43	4.15	4.25	5.50	–4.25	5.50
Reinforcing bars, ¾ in. and larger, 100 lb.	–2.68	3.20	3.50	2.68	3.08½	3.57½	2.90	3.75	3.25
Steel pipe, black, 3½ to 6 in. lap, discount	51%	–57.65%	45%	57%	58.9–5%	38%	51.8%	50%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	+45.00	54.30	42.60@44.10	47.80	+72.00	50.00	53.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.40	+2.69	2.55	1.97	2.26	3.10	2.84	3.10	3.12
Gravel, ¾ in., cu.yd.	1.75	–1.85	2.25	1.65	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd.	–1.00	–1.25	2.25	1.65	.50	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.80 to 1.90	–2.00	3.20	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+47.50	38.00	37.00	48.00	35.00	50.00	30.00	24.00	120.00
Lime, finishing, hydrated, ton	16.99	19.00	25.00	18.00	29.00	30.00	22.00	–27.00	21.00
Lime common, lump, per bbl.	–3.39@3.69	–1.50	2.75	1.40	1.40	2.95	1.90	+3.25	15.00
Common brick, delivered, 1,000	18.40	–9.00	12.72	11.00	17.00	14.00	18.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	–.0675	.124	.0821	.092	.09	.12½	.10	.08@.29
Hollow partition tile 4x12x12, block	.11120	–.0675	.124	.0657	....	.10	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.72	–.79	–.85	+.76	.80	+.92	.83	.79	.85
Common Labor:									
Common labor, union, hour	.75	.35	.....	.72½	.50	.50@.55	.75	.50@.60	....
Common labor, non-union, hour	.....	.20	.35@.45	.35@.40	.50	.35@.40	.50@.55	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. **Dallas** quotes lime per 180-lb. bbl. Steel, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. **Seattle** quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.2 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

The only advances in prices of construction materials, reported from eight representative American cities, occur in cast-iron pipe, cement, lumber and linseed oil. Cast-iron pipe is quoted in Atlanta at $45 as against $40.50. Cement has advanced 9c. per bbl. in Atlanta. Pine lumber is quoted at $42.50, wholesale, as against $40 per M ft. in New York. Linseed oil advanced 2c. in Denver and Chicago, but dropped 8c. in Dallas and 6c. per gal. in Atlanta. Increased demands in these four commodities have been reflected in stimulated prices; while twelve of the other principle materials in the construction market show a downward trend in price.

The minimum of $1.50 on steel shapes and bars continues to be quoted, on large tonnages, at the Pittsburgh mills; small tonnages 5c.@10c. per 100-lb. higher. Regardless of the stability of the mill price on large tonnages, the New York warehouses quote a drop of 10c. per 100-lb. on structural shapes and reinforcing bars. Shapes are quoted at $2.78 as against $2.88 and bars at $2.68 as compared with $2.78 per 100-lb., previously.

Structural rivets are quoted in Seattle at $4.25 as against $4.50 per 100-lb. Atlanta quotes reductions ranging from 10c to 15c. per cu. yd. in all concreting materials excepting cement; a drop of 10c. per bbl. in common lump lime; a decrease of $1.50 per 1000 in common brick and a slight reduction in hollow tile. New York quotes sand at $1 as against $1.25 per cu.yd. and common lump lime at $3.39@$3.69 as compared with $3.69 per bbl., formerly.